Cleaner Production Technologies

Export Opportunities in China

U.S. Department of Commerce
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TRADE ADMINISTRATION

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U.S. Department of Commerce
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Contents

Abbreviations and Acronyms

A/A/O	anaerobic-anoxic-aerobic activated sludge
AB	absorption-biodegrading
ADB	Asian Development Bank
A/O	anaerobic-aerobic activated sludge
AWWA	American Water Works Association
BAF	biological aeration filter
BET	Beijing Economic and Technological (Development Zone)
BJET	Beijing Golden State Engineering and Technology Co., Ltd.
BOT	build-operate-transfer
CAS	conventional activated sludge
CASS	cyclic activated sludge system
CAST	cyclic activated sludge technology
CIEPEC	China International Environmental Protection Exhibition and Conference
DAT–IAT	demand aeration tank–intermittent aeration tank
DBO	design-build-operate
DIN	Deutsches Institut für Normung
EIA	environmental impact assessment
EIF	EIA form
EIR	environmental import registration
EMS	Environmental Monitoring Station
EPB	environmental protection bureau
EPI	environmental protection institute
EPL	Environmental Protection Law
Ex-Im Bank	Export-Import Bank of the United States
GDP	gross domestic product
GEF	Global Environment Facility
ICEAS	intermittent cyclic extended aeration system
JBIC	Japan Bank for International Cooperation
M&A	merger and acquisition
NPC	National People's Congress
P3	private and public partnership
PFS	polymeric ferric sulfate
PRC	People's Republic of China
SBR	sequencing batch reactor
SDB	State Development Bank
SEPA	State Environmental Protection Administration
TDA	U.S. Trade and Development Agency
TSP	total suspended particulate
UASB	upflow anaerobic sludge bed

UCT	University of Cape Town
UNDIP	United Nations Industrial Development Organization
WB	World Bank
WPL	Water Pollution Prevention and Control Law
WTO	World Trade Organization

Note: Unless otherwise noted, dollar figures given are U.S. dollars. The exchange rate for the Chinese yuan, or RMB, has been calculated at approximately 8.3 to the U.S. dollar.

Executive Summary

Cleaner production as an environmental pollution preventive practice was systematically introduced into China in the 1990s. Since then, China has taken considerable efforts to conduct regulatory, institutional, and policy reform to promote cleaner production throughout the country.

The progress toward cleaner production in China has included drafting cleaner production technical standards and requirements, undertaking cleaner production audits, establishing eco-industry parks, improving international cooperation projects, and establishing demonstration projects supported by the Chinese government. On the whole, the cleaner production industry in China is becoming more mature, with local governments taking the initiative to implement cleaner production.

The Chinese government has strongly supported the drive for increased research and development in the area of cleaner production technologies and equipment; however, practical implementation is still limited. This limitation is partly the result of weak financial incentives and an inability to finance technical upgrades, but more complex underlying reasons, including institutional issues, may play a constraining role. Currently, most domestically produced equipment is technically behind the more advanced international products. For example, China does not have the capacity to design and construct badly needed flue gas desulfurization equipment for power units with a capacity greater than 200 MW. This technology lag suggests there are significant market opportunities for foreign companies to supply more advanced technology and equipment to take advantage of China's cleaner production requirements.

Cleaner production technologies and equipment required in China include the fields of desulfurization, dedusting, solar and wind energy, recovery/reuse of gangue[1] and ash, and the utilization of domestic waste. China also has published an officially recommended list of preferred industrial cleaner production technologies based on its existing production capabilities. These technologies, products, and services may represent good opportunities for business growth in China.

There are potential risks in technology and equipment investments in China, regardless of the positive signals sent by the government and industry. These risks include incomplete strategies and a lack of cleaner production awareness at the senior management level. A thoroughly researched market entry strategy should be conducted by any enterprise wishing to enter and succeed in China's quickly evolving cleaner production sector.

1. "Gangue" refers to the other secondary minerals in an ore deposit such as sand, rock, and other impurities surrounding the mineral of interest in an ore. In China, there are numerous large deposits of gangue remaining from primary ore mining operations.

CHAPTER 1

Background

Cleaner production (CP), as an environmental pollution preventive practice, was systematically introduced into China in the 1990s. The Chinese government used a "win-win" approach to its promotion strategy to balance economic and environmental objectives. In response to the United Nations Conference on Environment and Development in 1992, China has devoted itself fully to a sustainable development strategy, including the preventive CP approach. CP became one of the main national environmental strategies; in 1993, China declared that a reorientation toward CP was the irrevocable path to construct a modern industrial society. In China's Agenda 21 published in 1994,[1] CP was regarded as the key strategy for achieving national sustainable development goals. CP then began to be implemented as demonstration projects in industrial sectors.

Supply and Demand: Current Conditions and Trends

In general, the development of CP in China can be divided into three stages. The first stage, from 1983 to 1992, was the introduction and formative stage, during which China introduced and promoted the concept of CP into the country. The second stage, from 1993 to 2002, was dominated by the establishment of related policies and regulations. The third stage began in 2003 when the Cleaner Production Promotion Law (CPPL) of China was enacted. In the coming years, Chinese enterprises and governments are expected to further embrace CP technologies.

The Chinese government has made significant efforts to establish a suitable management system for CP issues. By the end of 2001, 28 CP centers had been founded. These included 1 national CP center, 5 industrial centers (petrochemical, chemical, metal, aero, and light industry), and 22 provincial CP centers. The responsibilities of the CP centers are mainly to introduce CP technologies to Chinese enterprises, to conduct international cooperation, and to publish related journals and books to distribute current knowledge and technologies.

Several laws and regulations have been issued requiring and encouraging enterprises to use CP technologies and management concepts. The Chinese government has a very important technology development program—the famous 863 program. In this program, many CP-related technologies intended for development have been listed in the resource and environment field. Local authorities, such as the provinces of Guangdong, Liaoning, Shandong, Jiangsu, Anhui, and Shaanxi, and the cities of Shenyang and Taiyuan, have issued their own policies regarding the implementation of the CPPL.

CP Activities

In the past 10 years, most CP activities consisted of the following:

Demonstration in Enterprises and CP Audits

Since 1993, 24 provinces or autonomous regions have developed CP demonstration projects. The projects targeted heavily polluted industries in the chemical, building materials, metal, power, medical, mining, electronics, mechanical, and textile sectors. The former State Economic and Trade Commission implemented 329 comprehensive CP projects since the ninth five-year plan, with an investment of US$9.6 billion. By the end of 2001,

the number of CP demonstration projects had exceeded 700. Reductions in 78,000 ton/year of chemical oxygen demand (COD), 1,260,000 ton/year of wastewater, and 0.8 billion m^3/year of waste gas were realized since the CP audits and demonstrations were initiated. These projects were mostly carried out via bilateral cooperation, and the donors included the United States, the United Kingdom, Australia, Canada, the European Union (EU), and the United Nations Development Programme (UNDP).

CP audits are a very important part of the overall CP demonstration activities in company facilities, and it appears that they have been the main activity since the CPPL was enacted. In most of the CP schemes for demonstration enterprises, technical innovation also plays an important role.

Training and Publicity

Another way to promote the concept of CP in China is training. As of 2003 more than 11,000 people had attended CP-related training programs in China. Approximately 50 training classes and 400 CP auditor-training programs have been held with publications and training materials specifically developed for Chinese users.[2] The most influential publications include *Cleaner Production—Concept and Practice, Manual for Cleaner Production Auditing, and Guideline for Implementing Cleaner Production*. Some of the training courses were conducted through international cooperation projects.

Obstacles, Effort, and Development

Although the CP initiative has been developed over the past 10 years, there are still several obstacles and challenges for governments and companies to overcome to promote CP technologies further. The challenges include the following:

- Managers in most Chinese companies have not acknowledged the importance of CP technologies in production. In China, as elsewhere, support from senior management is very important in adopting any new technology.
- Although there have been a number of laws or regulations on the promotion and implementation of CP in China, few practical policies exist to help companies overcome obstacles such as a lack of funding.
- Environmental management is still focused on the "end-of-pipe" control.
- Partly because of the wide range of CP technologies, no comprehensive or complete lists of appropriate CP technologies in China exist.
- Guidelines and methods for introducing CP are in great demand, but companies cannot easily get the CP technology and information they need.

The energy unit consumption rate is 40 percent higher for energy-intensive industries in China than in developed countries. Similarly, energy consumption as measured by gross domestic product (GDP) is 2.3 times the average world level. On the basis of this elevated energy consumption rate and the associated heavy environmental pollution, there is great potential for adopting cleaner production technologies in China.

In general, the regulations on developing CP technologies lack the necessary force for effective implementation. Since 1992, the Chinese government has tried to treat CP as one of the country's most important measures in its sustainable development strategy. The CP regulations have started to change from principled regulations to more detailed compulsory regulations. CP in China is now more integrated into the decision-making and policy activities of the Chinese government, which could provide a more certain future for the promotion of related CP technologies.

Although there are no comprehensive or systemic lists of CP technologies in China, the government encourages those technologies most effective in CP (especially in energy efficiency). Of the 10 major development areas in the 10th five-year plan of environmental industry four are related to CP: air pollution prevention, water conservation technology and equipment, comprehensive resource utilization, and CP technology and equipment. In the 10th five-year plan, China encouraged (1) the development of technologies with high efficiencies, (2) reduced waste generation, and (3) replacement of low-efficiency equipment. The plan also indicated that CP technologies and equipment in subsectors, such as the metal, chemical, light industry, non-ferrous metal, power, and coal industries need greater promotion. In the section of the plan on environmental services, the

government encouraged consulting services such as CP technology services, environmental technology development, management services, and information services. The plan emphasized expertise in the fields of environmental engineering, environmental technology research, environmental impact assessment, and environmental monitoring.

In 2005, the gross environmental industry product value may account for about 3.7 percent of GDP, with a total gross value of US$12 billion. The environmental industry is estimated to grow over the next three years to be about 12 percent per annum and to exceed the country's average GDP.[3]

International Cooperation

China has cooperated with many international organizations and foreign governments to promote CP over the past 10 years. The international cooperation projects include the 15 projects detailed in the following paragraphs:

1. China–Norway CP Project

China-Norway Cooperative Program on Cleaner Production (Phase I and II) (1993–1995) focuses on upgrading expertise and training and improving environmental management at the national and local level.

2. World Bank CP Project

- Promotion of CP in China
- Pollution control in the chemical industry
- CP component in Southwest Poverty Reduction Project
- Shandong Environment Project—CP Fund
- CP component in Qing-Ba Regional Poverty Reduction Project
- Promotion of international pollution prevention technology in China
- Liao River Basin Project
- Second Beijing Environmental Project
- Hebei Urban Environmental Project
- Huai River Pollution Control Project

3. United Nations Industrial Development Organization (UNIDO) Funded CP Project

- China National Cleaner Production Center Project
- CP Demonstration Project in Pulp and Paper Industry in China (Phase I and II)

4. U.S. Environmental Protection Agency (EPA) Funded CP Project

- Promotion of International Pollution Prevention Technology in China (1995–1996)

The purpose of this project was to promote pollution abatement practices and provide export opportunities for U.S. environmental services and technologies. The main activities were awareness raising, training, workshops, demonstrations, evaluations, and promotions of CP and pollution prevention (P2) in pharmaceutical, petrochemical, and metal finishing and six pilot companies.

5. Swedish International Development Agency Funded CP Project

- CP Demonstration Project in Pulp and Paper Industry in China (Phase I and II)
- Environmental aspects of a wastewater treatment plant from a life-cycle perspective (in Nanyang, includes CP component)
- Gao Bei Dian Wastewater Treatment Plant and Training Center, Beijing
- Energy saving and pollution abatement in Jiamusi paper mill, Heilongjiang Province
- Environment-friendly district heating in China

6. United Kingdom (Department for International Development) Funded CP Project

- CP component in Shanghai Urban Reconstruction Project financed by the U.K. government
- Support Program for the Urban Rehabilitation of Shanghai

7. Canadian International Development Agency (CIDA) Funded CP Project

- The China–Canada Cooperation Project in Cleaner Production (1996–2001)

8. China–Australia CP Project

- China–Australia Cooperation Program on CP

9. Asian Development Bank (ADB) Funded CP Project

- Technical Assistance Cluster for the Promotion of Clean Technology (2001–2003)
- Center for the Transfer of Environmentally Sound Technology (1997–1998)

10. EU Funded CP Project

- CP component in China–EU Liaoning Integrated Environmental Program
- Environmental Management Cooperation Program—designed to help increase the impact of the Administrative Center for China's Agenda 21 and other institutions on the development of environmental planning and management in China to increase sustainable development awareness
- Vehicle Emission Control Project
- Capacity building for municipal solid waste management reform—cities of Mianyang and Zhang Zhou
- Natural Forest Management Project—Hainan, Hunan, and Sichuan provinces
- Energy/Environment Program—throughout China
- Water Buffalo Development

11. UNDP Funded CP Project

- Capacity building for widespread adoption of CP for air pollution control in Benxi
- Demonstration project for phasing out ozone-depleting substance in the solvent sector in Shanghai
- Sustainable Development Networking Program
- Capacity building for the rapid commercialization of renewable energy in China
- China's Sustainable Development Program

12. United Nations Environment Programme (UNEP) Funded CP Project

- China National Cleaner Production Center Project
- CP Demonstration Project in the Chinese Pulp and Paper Industry (Phase I and II)
- Promotion of international P2 technology in China
- Sustainable Shenyang Demonstration Project
- Sustainable Wuhan Demonstration Project
- Preparation of a Diagnostic Study for the Lake Erhai and Xier River Basins, China, to contribute to investment planning for regional sustainable development
- Environmental impacts of trade liberalization in the cotton industry
- Financing CP

13. China–Japan CP Project

- Japan's environmental official development assistance for China

14. China–Germany CP Project

- Strengthening the Dongying City Environmental Protection Bureau
- Integration consulting group

15. China–Netherlands CP Project

- China National Cleaner Production Center—project of UNIDO supported by the Netherlands.
- IVAM (an innovative research agency) environmental research

Review of Overall Use and Subsector Applications of CP Technologies in China

Review of Overall Use of CP Technologies in China

No reliable or comprehensive figures are available for the implementation of CP technologies. Most of the CP technologies are distributed in the petrochemical, chemical, metal, aerospace, and light industry sectors.

CP in China is mainly practiced through CP audits and training and technology innovation. Many parts of the CP audits and training are related

to bilateral cooperation. Most of the technology innovation comes from upgrading existing production lines. Energy savings and more comprehensive use of resources are the main achievements.

During the ninth five-year plan period, energy consumption per 10,000 yuan RMB of GDP decreased about 30 percent, from 3.97 tons of standard coal in 1995 to 2.77 tons in 2000. The energy saved is equivalent to a reduction in the emission of 8 million tons of sulfur dioxide (SO_2) and 180 million tons of carbon dioxide (CO_2). The gross product value of the use of wastewater, solid waste, and waste emissions (three waste materials) has reached US$15.1 billion, increasing annually by 16.4 percent during 1995–2000.

Developing technologies for energy saving and comprehensive use of resources are high on the government's agenda. The energy saving and comprehensive use of resources projects were supported by the state bond and national special technology development program.[4]

Successful energy saving technologies and comprehensive resource utilization achievements included the following:

- Regenerative heating furnace technology
- 75 tons/hour dry quenching of coke
- Large-scale aluminum electrolytic tanks
- 130 tons/hour and 220 tons/hour circulating fluidized bed (CFB) boilers
- Mixed coal–water fluid combustion as an energy saving technology

Other successful technologies included:

- Caustic sludge recovery
- Sulfuric acid and cement co-production from phosphogypsum
- Gangue in brick making
- Gangue and coal slime mixing as fuel for power generation
- Blast furnace gas for power generation

Review of Subsector Application of CP Technologies in China

Pulp and Paper

The data for 1999 reveal more than 2,500 paper production companies in China with a total annual production of 21.6 million tons of paper and a profit of US$354 million. China has become the third largest paper-producing country in the world. In 2000, the total production of paper increased to 35 million tons. It is expected that the annual paper output will reach 45 million tons and 60 million tons in 2005 and 2010, respectively.

In the last five years, paper producers have increased their investment in environmental protection projects along with technical innovation and infrastructure construction. Average COD discharges per enterprise decreased by 61 percent between 1996 and 1999; however, paper industry pollution is still very significant. According to a report in 2001,[5] the total wastewater discharge from the paper industry was 3.53 billion tons or 18.6 percent of all the industrial wastewater generated in China.

The major characteristics of China's paper industry are the large number of enterprises, the small average scale, and the antiquated production technologies. The gap between current techniques and CP techniques is very significant in this industry and presents a large potential for CP in these companies. The primary hurdle preventing these companies from introducing updated technology and equipment is the lack of capital and the means to attract such investment. Because of this problem, only 39 percent of the projects for technical renovation listed in the ninth five-year plan were finished, and only 42.5 percent of the total budgets were realized by 2000. The industry has undergone some technical progress because of these initiatives, and, for example, China can now design and manufacture equipment for wheat straw alkaline recovery systems. This technology has been implemented at 18 paper operations.

Power and Energy

The power industry has a significant role in the economic and social development of China. China's energy industry output was 1.39 billion standard coal units in 2002—the third highest in the world. China's energy consumption is 1.48 billion standard coal units—the second highest in the world.

The energy production industry in China is primarily coal based, and coal-fired units will continue to be the primary energy generators in the power industry. In 2001, the total capacity of the thermal units with flue gas desulfurization (FGD)

was 5,000 MW, which represents only 2 percent of the total capacity (252,800 MW) of all Chinese thermal units. The emission reduction of SO_2 is mainly achieved by closing small thermal units and using low-sulfur coal in the acid rain and SO_2 control zones. However, the overall SO_2 emissions have not yet been effectively controlled. From 1998 to 2002, the contribution of coal-fired power plants to the total amount of industrial SO_2 emissions increased from 42.3 percent to 54.2 percent, and acid rain falls in many areas. China is attempting to control all of the pollutant emissions from coal-fired power plants to 2000 levels.

In the past 10 years, China's power industry has made progress in raising energy efficiency and reducing pollution through the implementation of new technologies. The internationally recognized CFB combustion technique has been applied in the industry, and the similarly recognized pressurized fluidized bed combustion is under pilot test. Also, the demonstration of integrated gasification gas combined cycles is being implemented, the 600,000-kW supercritical generator is under construction, and a set of combined cycle gas turbine projects has begun.

Several pollution control technologies in the power industry were developed in China. They include the wet FGB method, CFBs, and a low nitric oxides burning technique.

Cement

In 2001, the output of cement was approximately 640 million tons, which is about one-third of the total global output. There are approximately 4,471 cement facilities in China located throughout the 31 provinces. The average production per facility is about 460,000 tons. The technical level of these companies is far behind that of developed countries.

The major pollutants from the cement industry are cement kiln dust, SO_2, CO, CO_2, wastewater, and nitric oxides. In 2000, the discharge of particulate matter from this industry reached 8.09 million tons, which was 40 percent of the total particulate matter discharge of all industries in China. Similarly, dust discharges were 7.68 million tons, which was 70 percent of the total dust emission for all industries.[6] In addition, the energy consumption by these producers is much higher than in the developed world. The average power consumption in China is 114 kWh/ton of cement, whereas that in more developed countries is about 92 kWh/ton. The loss of heat in production in China using standard insulation indexes is 5,121 kJ/kg, whereas in Japan it is only 2,900 kJ/kg.

The current dominant techniques in China include the following:

- New-type drying kiln
- Wet rotary kiln
- Normal drying rotary kiln
- Mechanical shaft kiln

The new-type drying kiln is a better technique; it has a high output and low energy consumption. The wet rotary kiln and normal drying rotary kiln are not as good as the new-type drying kiln. The mechanical shaft kiln should be phased out because of its low efficiency. In China, the new-type drying kiln has been employed in some enterprises, but these enterprises are located only in some developed areas.

National cement industry policy does not allow installation of a new shaft kiln, wet rotary kiln, Lepol kiln, or drying hollow kiln. Existing shaft kilns should be closed down. However, kiln technologies with a preheating chamber to increase materials conversion efficiently are strongly recommended as a replacement for shaft kilns.

Textiles

Textiles is an industry sector that generates large volumes of wastewater discharge. Its wastewater discharge amount ranks sixth for all the industries in China. According to the *2001 Report on the State of the Environment,*[7] the textile industry accounted for discharges of about 1.26 billion tons wastewater, 157.7 billion m^3 of waste gas, and 4.37 million tons of solid waste in 2000. These wastes represent 6.64 percent, 1.14 percent, and 0.54 percent, respectively, of total national industrial discharges.

To control wastewater pollution, the government issued the Textile Industry Wastewater Pollution Prevention Technical Policy; the core concept of the policy is CP. According to data from 40 enterprises, wastewater discharges can be reduced by 10 percent to 30 percent, and pollutants can be reduced by 5 percent to 20 percent after conducting CP and CP audits.

The textile technical policy identifies technology and equipment that is either encouraged, restricted, or should be discontinued. Printing and dyeing enterprises are encouraged to adopt CP processes and technology and are required to control water consumption, wastewater discharge, and pollutant generation strictly. The CP initiatives promoted in the printing and dyeing industry are selected from the *Cleaner Production Technology Guideline Directory for National Priority Enterprises*;[8] they include water conservation, pollution discharge reduction, reclamation and reuse, and substitute dyes. Some examples of pollutant discharge reduction processes that are encouraged include cellulose enzyme for washed denim, replacement of high-efficiency reactive dye for common reactive dyes, and enzymatic desizing processes.

Metallurgy

There has been rapid growth in both the supply and demand in the metal industry. By the end of 2000, the production of steel and iron was 134 million and 120 million tons, respectively. However, much of the technology in the industry is antiquated and inefficient. Many enterprises have not started to use advanced mineral processing technologies; some large-scale enterprises still use heat sintered ore. The molten iron pretreating technology and external refining technology was applied only in a very small number of enterprises. Small-scale shaft furnace, steel making, and steel rolling plants exist in many places in China. Generally, the metallurgy industry has excessive energy consumption and generates large amounts of pollution.

The energy consumption per ton of steel in China is 20 percent to 30 percent higher than the world average level. The main reasons are that—

- The ratio of iron to steel is too high,
- The blast furnace top pressure power generation technology and dry quenching process is applied in a very narrow range, and
- Energy and heat recovery is low for blast and rotary furnaces.

Water consumption per ton of steel in China is also very high and is three to five times that of countries such as Germany and Japan.

Pollutants discharged by the steel industry represent a large proportion of all domestic industrial discharges. Dust, SO_2, and soot discharges from this industry rank second, third, and fourth, respectively, for these pollutants.

The primary CP measures to be implemented in this industry are innovating technology, upgrading production lines, replacing inefficient furnaces and blooming mills, and closing small-scale companies with steel production capacity of less than 100,000 tons/year. To date, 1,378 furnaces have been phased out, and 37 steel companies have been closed.

Some large Chinese companies have adopted CP measures and have demonstrated good performance in CP. These firms include the Baoshan Steel Group, Laiwu Steel Group, Capital Steel Group, and Wuhan Steel Group. Some also have obtained ISO14000 certification.

In the 1990s, the metallurgy industry Cleaner Production Center was created. This center conducts CP research, collects and transfers CP technologies and information, coordinates international cooperation, conducts CP training and CP audits, and assists government or companies in completing CP projects.

Chemical/Petrochemical Industry

The chemical industry has characteristically been one of the heavy polluting industries in China. The chemical industry accounts for approximately 5 billion tons of wastewater, 850 billion m^3 of waste gas, and 4.6 million tons of waste residues. The wastewater and waste gas discharge account for 22 percent and 8 percent, respectively, of total industrial discharges. The discharged quantities of wastewater, waste gas, and waste residues from this industry rank first, third, and fourth, respectively, for these industrial pollutants.

The production facilities in the chemical industry can be divided into three categories. The first type of facilities have been in operation for approximately 30 years and have exceeded their useful working life but are still operating. These facilities normally misuse large amounts of resources and create heavy pollution.

The second type of facilities have been in operation for about 10 to 20 years. These facilities can run steadily and produce consistent product, but the technologies applied are behind the best currently available technologies. Under the CP policy, these types of facilities are normally not in compliance with the appropriate CP practices.

The third type of facilities are those that have been in operation for less than 10 years. These facilities normally incorporate advanced technologies from the 1980s to 1990s, with many of them using imported technology. These facilities work well, generate fewer pollutants, and normally comply with appropriate CP practices.

The chemical industry has promoted mass load control and management, CP, and ISO14000 certification. Although the pollution trend is generally under control, P2 is just beginning. The main CP activities in this industry are CP training, audits, demonstration projects, technical innovations, and production-line upgrades. The production-line upgrades can have obvious beneficial capacity effects as well, but upgrades are relatively few because of limited capital.

In 1997, the chemical industry CP center was created. This center conducts CP research, collects and transfers CP technology and information, coordinates international cooperation, conducts CP training and audits, and assists government or companies in conducting CP projects.

Measures to Reform the Subsectors That Impact CP

Current Legislation

Cleaner Production Promotion Law (CPPL), Effective January 1, 2003

After the United States, China was the second country in the world to establish CP as a national policy that lays out a strategy for its promotion and implementation. CPPL illustrates the Chinese government's commitment to establish CP nationwide as one of China's key strategies for sustainable development. The National Development and Reform Commission (NDRC) and the State Environmental Protection Administration (SEPA) are the two key organizations in the government; other government agencies also play important roles.

In the CPPL, the government is clearly required to support and promote CP. In addition, the departments responsible for CP are defined as economic and trade departments. These economic and trade departments help other government departments to promote CP-related initiatives.

The law puts forward three different levels of CP requirements for company production and operations: instructive, imperative, and voluntary requirements. The voluntary requirements represent most of the total requirements, whereas there are few imperative requirements.

The law provides incentives for enterprises that conduct CP projects and provides opportunities to gain special tax treatment and finance support. Under CPPL, many provinces and industry subsectors have established their own CP regulations based on their own specific conditions.

In addition to the CPPL, the CP or P2 imperative also is reflected in several environmental laws. The relevant legislation is summarized in the following sections.

People's Republic of China Law on Energy Saving, Enacted by the National People's Congress January 1, 1998

This law provided upper limits for energy consumption per unit production in each industry subsector. These upper limits should not be surpassed by any enterprise. This law established the mechanism for phasing out outdated products and equipment with excessive levels of energy consumption. The law also provided for setting up an energy-saving labeling system.

Water Pollution Prevention and Control Law, Amended 1996

Article 22 of this law requires that enterprises adopt CP technologies to achieve higher efficiency of resource use and to reduce pollutant discharge. Enterprises should strengthen production-line maintenance to reduce the generation of pollutants.

Air Pollution Prevention and Control Law, Effective September 1, 2000

Article 15 requires that to reduce the generation of air pollutants, enterprises give priority to adopt CP technology, which has higher energy efficiency and generates less waste.

Solid Waste Prevention and Control Law, Effective April 1, 1996

Article 4 declares that the state encourage and support the adoption of CP technologies to reduce the generation of solid waste.

Environmental Protection Law, Effective December 1989

Article 25 requires that to establish a new production line or to upgrade the existing production line, process and equipment with high efficiency of resource utilization and less waste generation be employed. The waste should be used or treated with a cost-effective method.

New Policies and Regulations

The NDRC is planning to issue a number of policies and guideline documents related to the promotion of CP (P2), such as the *Cleaner Production Audit Guideline* and *Management Method on the Products and Wrappings*, which require recovery of materials. *The Cleaner Production Technology Guideline Directory for National Priority Enterprises* already has been issued. SEPA has issued several industry subsector CP standards, such as the *Petroleum Refining CP Standard, Coking Plant CP Standard, and Tanning Industry CP Standard*. More than 30 industrial subsectors, CP standards currently are under preparation.

Many provinces in China, including Guangzhou, Jiangsu, Zhejiang, Shanxi, Liaoning, Gansu, and Anhui, are issuing new regulations to encourage CP. Most provinces with CP regulations are either more economically developed or have heavy industry pollution problems.

Establishment of CP Demonstration Region, City, and Enterprises

NDRC has issued guidelines that defined a demonstration site program for CP promotion. These guidelines identify 10 cities (Beijing, Shanghai, Tianjin, Chongqing, Shenyang, Taiyuan, Jinan, Kunming, Lanzhou, and Fuyang) as demonstration sites for the promotion and introduction of CP. The guidelines also established five priority industry sectors for CP: petrochemicals, metallurgy, chemicals (nitrogen fertilizer, phosphate fertilizer, chlor-alkali, and sulfuric acid), light industry (pulp and paper, fermentation, and beer making), and ship building.

SEPA identified five rivers (the Huai He, Hai He, Liao He, Yangtze, and Yellow rivers) and three lakes (the Tai, Chao, and Dian Chi lakes), as having high environmental priority. The government emphasized CP promotion in the Tai Lake Watershed and will establish the Tai Lake Watershed area as the national CP demonstration center.

CP Training, Audit, and Promotion

According to statistics from the China National Cleaner Production Center, by 2002, approximately 560 CP training programs were held in China, and more than 11,000 people had attended such programs. The attendees included officers in the government or company managers, technical personnel in industries who will execute CP audits in their own facilities, and independent CP auditors.

Nearly 1,000 enterprises have conducted CP audits in China. The Liaoning Environmental Protection Bureau (EPB) decided to conduct CP audits in 800 large enterprises from 2001 to 2005. The Jiangsu EPB conducted CP audits in more than 100 enterprises in 2002. Most of the action plans obtained from the audit are medium- or low-expense audits primarily to improve the management system. High-cost action plans that require introducing new technologies were not normally considered because of a lack of financing.

World Trade Organization (WTO) Accession

China's WTO accession is not itself a measure to reform CP in the industry subsectors; however, China is aware that the global green agenda could be a potential obstacle to maintaining its global exports. China will strengthen reforms and take measures, including CP, to develop environmentally sound products to maintain and promote its export market.

Pending CP Regulations and Trends

After implementation of the national CPPL, the central government continued to issue supportive regulations and laws to make the CPPL more practical. There are many new laws, standards, and regulations related to CP, and some of the proposed standards and regulations are still to come. Table 1.1 describes the status and details of the pending laws, standards, and regulations.

In addition to the measures identified in Table 1.1, the Cleaner Production Technology Guideline Directory for National Priority Enterprises will be revised continuously.

Under the legislation framework of CPPL, the main task for the government will be to create a CP policy system in China. The central government has requested local governments to establish their own CP promotion plans, according to their local conditions. Methods to guide companies in implementing CP practices, supervising company CP audits and activities, and creating a financial environment to promote CP will be the main issues for future Chinese regulations.

Current CP Technology Policies and Initiatives

The current CP technology policies are represented in different laws and regulations as mentioned in a previous section of this chapter. These polices can be summarized as follows:

- The government encourages CP science and technology research at both the institutional and corporate level. Each level of government should identify the finance and revenue policies to support CP research. If a research topic is identified as CP related and has significant potential benefit, the government may offer financial support to conduct the research.[9]
- CP technologies are encouraged for new production lines and old production-line upgrades. This policy has a great potential impact for energy saving and P2, especially in large-scale projects. In many cases improvements have emphasized temporary economic development, and more long-term CP policy is often overlooked.
- The technologies for comprehensive resource utilization and waste recovery are strongly encouraged by the government. These technologies can realize expected profits through efficiency improvements as well as financial benefits from tax reduction support policies. Many enterprises have taken advantage of this opportunity.
- The government is responsible for organizing different departments or industry sectors to promote CP technology development. The government is also responsible for reducing risks for companies that pursue new CP technology by helping them identify usable CP technologies and equipment for their businesses.
- The government encourages companies to import CP technologies and adapt them to Chinese conditions. For foreign enterprises, this can lead to appropriate technology transfer or manufacture under licensed agreements.
- Government support to establish CP technologies information systems is provided in different types and forms. These information systems are intended to facilitate enterprises in obtaining or selecting CP technologies.

"The Chinese Sustainable Action Program in the 21st Century," issued by the state council in 2003, is a very important policy document designed to promote sustainable development in China.[10] It contains important CP technology policy, with an emphasis on improving energy efficiency and energy structures (for example, develop cleaner energy, cleaner coal, and co-generation), vigorously promoting CP, and participating in global environmental cooperation issues. The program also includes measures to promote CP by integrating technique progress, comprehensive resource utilization, and management systems enhancements.

To guide the enterprises in adopting CP technologies, the Chinese government has compiled and issued the *Cleaner Production Technology Guideline Directory for National Priority Enterprises.*[11] This directory covers the metallurgy, petroleum and chemicals, mechanical production, construction materials (cement), metal, textiles, pulp and paper, and light industries. The directory includes 113 CP technologies and practices, including raw material substitution, cleaner energy, technical innovation, new techniques and equipment development, equipment manufacture, energy conservation, and resource comprehensive utilization. Any company in China can access this directory and get information support from the government.

Table 1.1
Pending Laws, Standards, and Regulations

Name	Drafter	Objective of the Law/Regulation	Status
Industry Subsector CP Standards or Industry Subsectors Technical Guideline	SEPA	Establish the CP technical regulations in each industry subsector	Three standards have been enacted, and more than 30 other standards are under preparation
CP Audit Guideline	NDRC	Formulate the CP audit methods	Under drafting
Guideline for CP Promotion in Key Industries	NDRC	Promote the implementation of CP in enterprises	Drafting program began in 2003
Index System for Enterprise CP Evaluation	NDRC	Promote the implementation of CP in enterprises	Drafting program began in 2003
Management Method on the Products and Wrappings Compulsory for Reclaiming	NDRC	Promote the implementation of CP in enterprises	Drafting program began in 2003
Recycling Economy Promotion Law	NDRC	Promote CP and recycling economy	Study program began in 2003
Resource Comprehensive Utilization Directory	NDRC	Continually encourage resource comprehensive utilization	Revising program began in 2003
Guangdong Province CP Audit and Acceptance Standard	Guangdong Provincial Development and Reform Commission	Formulate the local CP audit methods and acceptance standard	Drafting program finished in 2003
Jiangsu Province CP Promotion Guideline	Jiangsu Provincial Development and Reform Commission	Form a local regulation under national CPPL	Preparing to start the drafting program
Shanxi Province CP Guideline	Shanxi Provincial Development and Reform Commission	Form a local regulation under national CPPL	Study program has begun
Zhejiang Province CP Audit Guideline	Zhejiang Provincial Development and Reform Commission	Formulate the local CP audit methods	Guideline was enacted in 2003
Instructions on Zhejiang Province CP Promotion in Industry Park	Zhejiang Provincial Development and Reform Commission	Strengthen CP promotion in industry park	Drafting program began in 2003
Regulation of Zhejiang Province to Implement the CPPL	Zhejiang Provincial Development and Reform Commission	Strengthen CP promotion in Zhejiang Province	Drafting is completed
Zhejiang Province Green Enterprise Guideline	Zhejiang Provincial Development and Reform Commission	Strengthen CP promotion in enterprises	Drafting is completed

Regarding preferential policies on finance and revenue, many provincial governments have detailed their conditions in relevant regulations. For example, the Guangdong Province CP audit and acceptance standard contains the following clauses:

- Companies conducting CP practices have priority to obtain low-interest bank loans and can get further tax exemptions or deductions.
- Companies identified as CP technology trial plants can apply for government financing.
- Companies that research CP technology can apply for access to a special government fund.
- Companies that implement resource comprehensive utilization projects or make use of wastes (wastewater, waste solid, and waste gas emission) to produce products can obtain income and value-added tax exemptions or deductions.

Building energy savings into development projects represents another big area for CP promotion. Many provincial governments have established their own plans and targets. For example, the Shanghai government has determined that until 2005, building exteriors should help reduce a building's energy consumption by 25 percent. Heating, ventilation, and air-conditioning equipment also should help to reduce the building's energy consumption by 25 percent. The exterior-protected construction of all new residential buildings should be in compliance with these energy-saving regulations. It is expected that these targets can be realized, because buildings constructed in Shanghai prior to 2000 had poor thermal efficiency.

NOTES

1. Sustainable Development Action Outline for the Early 21st Century in China, Web site: *www.chinapap.gov.cn/rkzh/zgrk/zywx/t20040326_2879.htm.*

2. Cleaner Production in China, Web site: *www.chinacp.org.cn/newcn/chinacp/forum-8.htm.*

3. The Current Status and Outlook on the Environmental Protection Industries in China, *China Environmental Protection Industry* 3 (2003): 38.

4. China has a national special technology development program. The objectives of this program are to rebuild traditional industry using high technology, to industrialize the high technology, and to optimize the structure of key industrial products and technologies.

5. The Discharge and Treatment of Industrial Wastewater from Industrial Sectors in 2000, Web site: *www.cct.org.cn/cct/content.asp?id=5754.*

6. Air Pollution Prevention of Cement Industry, *China Environmental Protection Industry* 3 (2003): 22.

7. China, State Environmental Protection Administration, *Report on the State of the Environment in China 2001* (Beijing: SEPA, 2002); available on the Web at *www.zhb.gov.cn/english/.*

8. *Cleaner Production Technology Guideline Directory for National Priority Industries* (Phase I), Resource Saving and Comprehensive Utilization Department of the State Economic and Trade Commission, September 2000.

9. Unfortunately, in reality, actual financial support for CP research is very limited in China.

10. Issued by the State Council of the People's Republic of China, January 14, 2003.

11. *Cleaner Production Technology Guideline Directory for National Priority Industries* (Phase I and II), Resource Saving and Comprehensive Utilization Department of the State Economic and Trade Commission, September 2000 and February 2003.

CHAPTER 2

Market Highlights and Best Prospects

Market Highlights and Developments Since 2000

Establishment of CP Technical Standards and Requirements

The CPPL requires the state to enact CP standards or technical requirements to direct various industries and companies to implement CP mechanisms. These standards or requirements were established under the management of the Science and Technology Standard Department and SEPA.

Currently, 3 CP standards have been formally enacted, 3 have been submitted for approval, and 30 standards or technical requirements have been published for comments. These standards or technical requirements are presented in Table 2.1.

On the basis of current technology, equipment, and management, the standards and technical requirements are classified as follows: Class I—international advanced CP level, Class II—domestic advanced CP level, and Class III—domestic basic CP level. During the classification of these standards and technical requirement, six issues were considered:

- Production process and equipment requirements
- Resource and energy use
- Product
- Pollutant generation
- Waste reclamation and reuse
- Environmental management

All the standards and technical requirements will be revised every three to five years.

Some institutes or organizations, including the China National Cleaner Production Center, local CP centers, industrial associations, CP centers, and environmental protection research institutes, were authorized to draft these standards and requirements. In addition, some companies were engaged in this work. For instance, the Dongfanghong Chemical Industrial Plant under the Beijing Chemical Industrial (Group) Company, Caihong Color Picture Tube General Plant, and Beijing Shougang Group, all respective industry leaders, participated in this process. It is expected that in the next several years, more standards and requirements will be stipulated and existing standards will be updated to create opportunities for various service providers.

CP Audit

In the past 10 years, CP audits have been the primary tool for enterprises that want to implement CP in China. Through CP audits, low-, medium-, and high-cost measures are identified, and technical upgrade and management improvement plans are developed.

Under the promotion of SEPA and the former State Economic and Trade Commission, CP audits have been conducted widely throughout China. By 2001, nearly 1,000 companies had conducted CP audits. These companies are represented by the chemical, paper, hotel, brewing, alcohol, electroplating, construction material, metallurgy, petrochemical, power, aircraft manufacturing, mining, electronic, tobacco, mechanical, textile and print-

Table 2.1
Existing CP Standards and Technical Requirements

Status	Name
Enacted	Cleaner Production Standard—Petroleum Refinery Industry (HJ/T 125-2003)
	Cleaner Production Standard—Coking Industry (HJ/T 126-2003)
	Cleaner Production Standard—Tanning Industry (pig leather) (HJ/T 127-2003)
Submitted for approval	Cleaner Production Standard—Plating and Surface Finishing Industry
	Cleaner Production Standard—Brewing Industry
	Cleaner Production Standard—Pulp and Paper Industry
Published for comments	Cleaner ProductionStandard—Iron and Steel Industry
	Cleaner Production Standard—Nitrogenous Fertilizer Industry
	Cleaner Production Standard—Edible Vegetable Oil Industry (soybean oil and soybean meal)
	Cleaner Production Standard—Garage Painting
	Cleaner Production Standard—Coal-Fired Power Plants
	Cleaner Production Standard—Cement Industry
	Cleaner Production Standard—Tobacco Industry
	Cleaner Production Standard—Nickel Processing Industry
	Technical Requirement for Cleaner Production—Medium-Density Fiberboard Industry
	Technical Requirement for Cleaner Production—Dairy Industry (pure milk and whole milk powder)
	Technical Requirement for Cleaner Production—Paper Industry—Production of Bleached Kraft Bagasse Pulp
	Technical Requirement for Cleaner Production—Basic Chemical Feed Industry (ethylene oxide and ethylene glycol)
	Technical Requirement for Cleaner Production—Iron Ore Mining and Mineral Processing Industry
	Technical Requirement for Cleaner Production—Oil and Natural Gas Exploitation—Thick Oil
	Technical Requirement for Cleaner Production—Chemical Fiber Industry—Polyester Fiber
	Technical Requirement for Cleaner Production—Chemical Fiber Industry—Acrylic Fiber
	Technical Requirement for Cleaner Production—Chemical Fiber Industry—Polyvinyl Alcohol Fiber
	Technical Requirement for Cleaner Production—Dyeing and Finishing of Cotton Industry
	Technical Requirement for Cleaner Production—Split Type Room Air-Conditioner Industry
	Technical Requirement for Cleaner Production—Hotels
	Technical Requirement for Cleaner Production Standards—Liquor Industry
	Technical Requirement for Cleaner Production—Spandex Industry
	Technical Requirement for Cleaner Production—Color Picture (Display) Tube Industry
	Technical Requirement for Cleaner Production—Aluminum Electrolytic Industry
	Technical Requirement for Cleaner Production—Cane Sugar Manufacturing Industry
	Technical Requirement for Cleaner Production—Meal Industry
	Technical Requirement for Cleaner Production—Petroleum Machining Refinery Industry
	Technical Requirement for Cleaner Production—Alcohol Indusrty
	Technical Requirement for Cleaner Production—Steel Rolling (Plate) Industry
	Technical Requirement for Cleaner Production—Coking Industry

ing, and transportation industries. Some local governments have undertaken CP audits as a long-term development strategy. For instance, the Liaoning Provincial EPB decided to promote CP audits in 800 large enterprises from 2001 to 2005. Also, the Jiangsu Provincial EPB conducted CP audits in enterprises for three years, and a large number of audits are ongoing in some regions that have been heavily polluted. For example, SEPA is now facilitating CP audits in more than 100 companies located in the Huai River Basin.

Before the CPPL was enacted, CP audits were guided by internal company administrative policies. The CPPL established the first legal requirements for enterprises to implement CP audits.

According to the CPPL, effective January 2003, companies must (1) monitor resource consumption and generation of wastes during the production and the provision of services and (2) conduct CP audits with respect to production and service procedures, as needed. In particular, companies classified in the following two categories are required to conduct CP audits:

- Companies that do not comply with the national or local discharging standards or do not comply with the total volume control targets for pollutants set by the relevant local people's governments
- Any company using toxic or hazardous materials in production or discharging toxic and hazardous substances

CP audits must be conducted periodically, and audit findings must be reported to the relevant administrative departments for environmental protection and economic and trade departments under the local people's government at or above the county level. In the pending CP Audit Management Methods Guidelines, compulsory audits may be required for specific companies, such as those deemed as heavy polluters. These laws and regulations will further drive the future development of CP audits and production standards in China.

Establishment of Eco-Industry Parks

An eco-industry park is an effective model to fully use resources efficiently, reduce resource consumption, and decrease pollutant discharges. In these parks, various companies have common feedstock and waste streams that complement each other. An example is the use of by-products or wastes as the raw material for another process. Some developed countries, such as the United States, Canada, and Denmark, have experience in the successful development of eco-industry parks.

In China, the establishment of eco-industry demonstration parks was initiated in 1999 with development of the Guigang State-Level Eco-Industry Park. With the support of relevant government administrations, the construction of eco-industry parks has gained rapid progress in recent years. It is reported that more than 10 eco-industry parks are under construction at present, including the following:

- Guigang State-Level Eco-Industry Demonstration Park (Sugar Industry), Guangxi Chuang Autonomous Region
- Nanhai State-Level Eco-Industry Demonstration Park, Guangdong Province
- Lucheng State-Level Eco-Industry Demonstration Park (Coal Industry), Shanxi Province
- Tuojiu Group Eco-Industry Park (Liquor Industry), Sichuan Province
- Lubei Chemical Eco-Industry Park (Chemical Industry), Shandong Province
- Wenzhou Eco-Industry Park (Chemical Industry), Guangdong Province
- Dalian Environmental Protection Industry Park, Liaoning Province
- Environmental Protection Industry Park, Hainan Province
- Yixing Environmental Science and Technology Eco-Industry Park, Jiangsu Province
- Quzhou Shenjia Eco-Industry Park (Chemical Industry), Zhejiang Province
- Changsha Huangxing Eco-Industry Park, Hunan Province
- Baotou State-Level Eco-Industry Demonstration Park (Aluminum Industry), Inner Mongolia Autonomous Region

In addition, the Dalian, Yantai, and Tianjin development parks are now undergoing conversion to eco-industry parks. To set up a successful eco-industry park, the companies in the park are required to adopt advanced technology and production processes. In addition, companies' material, energy, and information systems must be highly integrated inside the park.

Eco-industry parks are now at a critical development stage in China. Advanced production processes, technology and equipment, and management methods are all acutely needed in this field.

Industrial CP Technologies and Equipment

CP in industrial sectors is mainly conducted to promote water, energy, and raw material savings and to control environmental pollution. China's industrial performance in water, energy, and raw material consumption and waste generation is far behind that of developed countries; underdeveloped technology is the major reason for these deficiencies. For example, energy consumption per ton of steel produced in China is 20 percent to 30 percent higher than that of more developed countries. This elevated consumption results from (1) a relatively higher iron-steel ratio, (2) the low utilization rate of large-sized energy efficient equipment such as blast furnace overpressure power-generating equipment and coke dry-quenching equipment, and (3) the low energy/heat recovery rate of blast furnaces and rotary furnace gas.

To reduce industrial water, energy, and resource consumption and heavy pollution generation, the Chinese government has established specific plans to improve water conservation, energy efficiency, and comprehensive resource utilization. For example, in the metallurgy industry, the government plans to reduce the comprehensive energy consumption per ton of steel produced from 0.92 tons standard coal in 2000 to less than 0.8 tons standard coal in 2005. Also, the fresh water consumption per ton of steel produced will be decreased from 30 m^3 in 2000 to 16 m^3 in 2005. Similarly, in the textile industry, the government plans to reduce the energy consumption per 10,000 RMB Yuan (equal to US$1,209) of product value by 15 percent in 2005 compared with levels in 2000. Further, the recycling rate of industrial water in the textile printing and dyeing industry will reach 30 percent by 2005. The water consumption per 100 m of material in the printing and dyeing industry will decrease from 3.6 tons in 2000 to 3.0 tons in 2005. The other three biggest water consumers—coal-fired power, paper, and petrochemical industries—have water-saving objectives as well.

Technical innovation and upgrades are essential elements to achieve water conservation, energy efficiency, and pollution prevention objectives. This need in turn has created a large demand in advanced production processes and technology. The technologies listed in the *Cleaner Production Technology Guideline for Priority Enterprises*,[1] enacted by the former State Economic and Trade Commission, are believed to have attractive development prospects in the next few years in China.

CP-Related Projects

International Cooperative CP Projects

Since 1993, many international organizations and foreign governments have assisted the Chinese government in the development of CP. Some ongoing active projects are detailed in the following sections.

CP Component in China-EU Liaoning Integrated Environmental Program

The project period is from 2001 to 2005. The European Union has promised to grant 37 million euros and technical aid to China. The Liaoning Province government plans to raise another 21.5 million euros for the project. The Liaoning Province Cleaner Production Center is responsible for implementation. The project mainly attempts to—

- Promote CP in Shenyang, Anshan, Fushun, Benxi, and Liaoyang cities
- Establish demonstration projects to spread CP in companies
- Set up a CP fund worth 10 million euros to support enterprises' CP efforts
- Conduct policy study and improve relevant regulations

CP Technology Development Funded by the Asian Development Bank (ADB)

This project is a technical aid project funded by the ADB and initiated in February 2002 by the former State Economic and Trade Commission. This project primarily includes the following:

- Research on the problems existing in organizational structure, policy, and investment during the development and growth of CP technologies
- Research on CP financing mechanisms suitable for China

- Assistance for select companies in the application of CP technologies
- Eventual growth of CP in China

China-EU Environmental Management Cooperation Plan

The project period is from 2001 to 2005. The European Union and the Chinese government provided 13 million euros and 5.9 million euros, respectively, for this project. The main project activities related to CP include the following:

- Organizing environmental management training for industrial sectors and other stakeholders, including governmental administrations and investment institutes
- Conducting comprehensive environmental management demonstration in industrial development parks and eco-industry parks
- Facilitating and promoting environmentally sound technologies

Sino-German Zhejiang Province Enterprises Environmental Consultation

The project period is from 2003 to 2007. The German partner is responsible for securing capital financing. The main project content is to establish CP demonstration companies. A detailed CP plan will be set up, and CP audits will be carried out continuously in these enterprises.

During the implementation of these CP international cooperation projects, advanced management experience, technologies, and equipment will be needed.

Demonstration Projects of Resource Saving and P2 Organized by the Chinese Government

Sustainable development is a long-term strategy in China; this concept has been strongly emphasized by the Chinese government. In November 2002, the former State Economic and Trade Commission announced the implementation of 100 demonstration projects for resource conservation and environmental protection. The focus areas of the demonstration programs included CP, water and energy conservation, resource utilization, and renewable energy development and utilization. The initial stage of the program consisted of 40 projects with an investment of about US$927 million (mainly raised by companies and loans from commercial banks, partly funded by state bonds and capital from international cooperation projects). Most of these projects were required to use domestic technology and equipment. The projects that have the potential to introduce foreign products are presented in Table 2.2.

Best Sales Prospects for Applicable Air, Water, Solid Waste Technologies, and Design Engineering Services

Air P2 Technologies

Desulfurization Technology and Equipment

The total amount of SO_2 discharge in China has exceeded 20 million tons/year for many years, making the country the leading SO_2 polluter in the world. Coal-fired plants are the major source of SO_2 pollution and account for 50 percent of total SO_2 emissions. Coal-fired power plants generate 60 percent of the total electric power in China. Low-quality and high-sulfur coal is still widely used in China, thus generating these large amounts of SO_2. These SO_2 emissions and the subsequent generation of acid rain cause an estimated annual economic loss of US$12 billion.

To control SO_2 and acid rain pollution, relatively strict policies have been adopted in China, especially in the power and energy industry, including the following:

- By 2005, the SO_2 discharge of the power industry should be reduced by 10 percent to 20 percent compared with 2000 levels.
- Desulfurization devices must be installed on coal-fired boilers at power plants where medium- or high-sulfur coal is used.
- All newly built, expanded, or renovated coal-fired power plants must include installation of desulfurization equipment.

Economic measures also have been implemented to control SO_2 emissions. According to the *Regulation for Management of Pollutant Discharge*

Table 2.2
Selected Demonstration Projects for Resource Recovery and Pollution Prevention

Project Name	Project Description	Corporation
Processing of high-quality coal	This is a clean coal production demonstration project. International advanced binder technolgy will be applied, and a foreign model coal processing main engine will be imported. Internationally advanced in-line analytical devices will be introduced. The selection and washing process capacity will be 1 to 2 million tons, and the coal production capacity will be 0.5 to 1 million tons.	Shanxi Coal Transportation Corporation
Abandoned automobile detachment and disposal demonstration project	Scrap automobile detachment and fragmentation technology and equipment for automobiles will be imported. The detachment line disposal capacity will be 50,000 automobiles/year. The fragmentation production line for abandoned steel will be 400,000 tons/year.	Shanghai Baosteel International
Technical absorption and local production demonstration project—desulfurization technology and equipment for the thermal power units with the capacity of 200,000 kW	Thermal power unit with a capacity of 200,000 kW will be constructed with wet desulfurization equipment. The desulfurization rate will be 95 percent. Eighty percent of the equipment will be domestic, and the remaining equipment will be imported.	Beijing Shijingshan Power Plant
Technical absorption and local production demonstration project—desulfurization technology and equipment for the thermal power units with the capacity of 300,00 kW.	Thermal power unit with a capacity of 300,000 kW will be constructed with wet desulfurization equipment. Ninety percent of the equipment will be domestic, and the rest will be imported	Shandong Electric Power Corporation
Technical absorption and local production demonstration project—domestic waste incinerator with declining and reciprocating furnace bed and electricity generation technology and equipment	This is a demonstration project for domestic waste electricity generation. Domestic waste incinerators, heat recovery boilers, and dust purification systems will be installed. The capacity of each incinerator will be 600 tons/day. Ninety-five percent of the technologies will be domestic products, and the rest will be imported	Shenzhen Energy and Environmental Engineering Co., Ltd.

Fee Levy and Uses, effective July 1, 2003, the SO_2 discharge fee is levied throughout China. This regulation has imposed great pressure on power companies to install desulfurization equipment and has triggered huge demand for desulfurization equipment. The desulfurization industry has developed into a new market and is expected to continue strong growth in the future. It is estimated that the market value of the desulfurization industry will be US$725 million if only 5 percent of all the large-sized coal-fired power plants install desulfurization equipment.

On the issue of technology and equipment, imported wet scrubbing emissions control technology and equipment for generators of 200,000 kW and above is urgently required in China because the domestic market does not supply it. In addition, clean coal electricity generating equipment, such as CFB boilers, has a growing market potential.

Dedusting Technology and Equipment

China's industrial dust pollution comes mainly from steel, power, and cement plants. Dust pollution from the cement industry accounts for approximately 60 percent of the country's total amount generated. The industry generates approximately 12 million tons of dust per year, equivalent to 2.18 percent of China's cement output (550 million tons/year). Dust emissions have caused serious environmental pollution and accompanying economic losses.

The scarcity of effective dust collection equipment is the main reason for the high dust emissions in cement industry. Most of the non-rotary kilns produce 72 percent of the total cement output in China. China has no dust collection equipment or devices installed on some parts of rotary kilns and hence cannot comply with dedusting efficiency requirements. Thus, dust pollution is a key issue that China's cement industry must address, which will bring increased demand for high-efficiency dedusting equipment in China.

Currently, high-efficiency electrostatic precipitators and high-efficiency bag dust collectors have been introduced into China. The general level of domestic dedusting equipment in China is believed to be only at the level of Western countries in the 1970s, and the removal efficiency is far behind that of the current advanced removal levels. In particular, the fine dust removal efficiency of domestic equipment is still quite low.

Clean Energy

Air pollution and resource consumption from the use of fossil fuels is quite evident in China, especially the significant air pollution caused by coal-fired power plants. Compared with traditional energy methods, new energy sources such as solar and wind energy are attractive because they are both clean and renewable. These properties have led the Chinese government to emphasize the exploitation of new energy sources in recent years.

The development of solar energy dates to the 1970s in China. After nearly 30 years' development, China is the world leader in the use of solar energy resources. The Chinese government has developed ambitious plans to promote solar energy products in the coming years. NDRC reports it will raise US$1.2 billion to promote the application of solar energy photovoltaic generation technology in the next five years. China also plans to bring the capacity of photovoltaic generation systems to 300 MW in 2005. In addition, a Global Environment Facility (GEF) project worth US$25 million (funded by the World Bank) was initiated in 2001 to install solar systems with a combined capacity of 10 MW in China's rural areas from 2001 to 2005. Currently, the end-users of solar energy products mainly inhabit the wide rural areas in China's northwestern regions, such as the Xinjiang Uighur Autonomous Region, Qinghai Province, and Tibet Autonomous Region. Large cities like Beijing also represent potential centers of high demand for solar energy products, and solar energy has been identified as the main energy source for the 2008 Olympic Games.

Wind energy is another clean energy source that has large potential application in China. According to official data,[2] the total capacity of wind farms in China reached 444,405 kW by the end of 2002. Nearly 30 wind farms have been put into operation, and another 10 are under construction. These wind farms are located in northwest China (Xinjiang and Gansu provinces), northeast China (Inner Mongolia, and Hebei, Liaoning, Jilin, and Heilongjiang provinces), and coastal areas (Fujian, Zhejiang, Hainan, and Shandong provinces). Both state bonds and World Bank loans have been used to fund wind farms in China. In addition, preferential tax policies have been developed to promote wind power, and electricity generated by wind farms has been permitted to connect to the power network. This financial and policy support has created sound development prospects for wind power generation and is expected to continue in the future.

The following equipment related to solar and wind energy is presently in the *List of Advanced*

Technologies and Equipment Encouraging Foreign Investment, issued by the Ministry of Science and Technology and Ministry of Commerce in June 2003:[3]

- Solar energy cells and components
- Large-sized wind-driven generator with the capacity of 1,000 kW and greater than 1,000 kW
- Blades for the large-sized wind-driven generator with the capacity of 1,000 kW and greater than 1,000 kW
- Integrated and long-distance monitoring and control system of wind farms
- Controller and inverter for wind-driven generator

Water P2 Technologies

Industrial wastewater pollution has occurred widely in various industrial sectors, including pulp and paper, textile, food, and chemical/petrochemical industries.

The pulp and paper industry is one of the major generators of industrial wastewater in China. Wastewater from this industry accounts for 10 percent to 12 percent of the total industrial wastewater generated in China. The COD from pulp and paper accounts for 40 percent to 45 percent of the total COD generated from Chinese industrial wastewater discharges. Seventy-four percent of the COD discharged in the pulp and paper industry comes from straw pulping, making pollution caused by straw pulping a very serious pollution issue in China. The primary issue is from the generation of digesting black liquor and effluents in the mid-pulping stage. For digesting black liquor, conventional combustion for alkaline reclamation is needed; for effluents in the mid-pulping stage, secondary biological treatment is needed. High-efficiency treatment is required for both of these technologies, with desired alkaline reclamation rates of more than 85 percent.

The textile printing and dyeing industry is another sector that significantly contaminates China's environment; it is the sixth largest industrial wastewater source in China. Because of the size of this industry in China, a high demand for appropriate wastewater treatment technologies and equipment has emerged in this sector. Currently, biological, physical, and physical–chemical processes have been applied to treat this wastewater, which include aerobic, anaerobic–aerobic, sedimentation, and coagulation treatment. The current biological treatment can achieve 70 percent COD and 95 percent biological oxygen demand (BOD) removals; however, 30 percent of COD is still contained in the effluent. In recent years, new treatment processes, such as biological activated carbon and photocatalytic oxidation technology, have been developed. These processes appear to be more efficient at removing non-biodegradable organics. It is believed that high-efficiency treatment technologies like these will have a growing demand from the implementation of CP in China. In addition, dye reclamation technology and equipment such as reverse osmosis are considered to be CP markets needed in the next few years.

Food industry wastewater generally has a high concentration of multiple pollutants that are readily biodegradable. As a pollution source directly related to eutrophication (enrichment) of surface water bodies, food wastewater treatment has attracted wide concern. Currently, biological processes have been applied in this field successfully. However, resource reclamation is a treatment method that has good development prospects in China. Technologies that can collect edible vegetable oil, protein, and starch from food wastewater using non-toxic coagulants and enzyme agents are needed in this industry.

Chemical industrial wastewater is mainly discharged from the petrochemical, coal chemical, acid and alkaline, fertilizer, plastics, pharmaceutical, dye, and rubber industries. Two primary methods are used to implement water pollution prevention for the chemical industry: technical renovation and wastewater treatment. Technical renovation is a fundamental measure to reduce pollutants generated and more effectively use production resources. In the field of wastewater treatment, physical, physical–chemical, and biological processes have been widely applied. Furthermore, to improve effluent quality, activated carbon adsorption, ozone oxidation, ion exchange, and membrane separation technologies have been adopted to achieve improved treatment. High-

efficiency and advanced treatment technology and equipment are badly needed in China. In addition, given the serious eutrophication of many major water bodies in China, there is a huge demand for nitrogen and phosphorus removal technology.

Solid Waste P2 Technologies

Comprehensive Utilization of Gangue

Gangue is the solid waste generated from coal mining and the coal selection and washing process. It is the largest solid industrial waste generated in China, with approximately 100 million tons generated annually or 10 percent of the total coal output. To effectively use gangue, the former State Economic and Trade Commission and Ministry of Science and Technology enacted the Technology Policy on Gangue Comprehensive Utilization in 2003. In addition, the Chinese government has enacted preferential tax policy to encourage the development of the gangue utilization industry. The policy is young; however, it is expected to positively influence technology development in this industry.

Gangue utilization mainly includes electricity generation from gangue and the production of gangue-based construction materials. Currently, investment in projects such as gangue-fed thermal power plants and other high-efficiency gangue utilization technologies and equipment is needed in China.

Comprehensive Utilization of Fly Ash

Fly ash is an industrial solid waste discharged from the many coal-fired boilers in thermal power plants in China. It has many applications, including concrete production, cement and other construction materials, road construction, and agricultural soil improvement. In the early 1990s, the Chinese government enacted the Technology Policy on Fly Ash Comprehensive Utilization, indicating the Chinese government's commitment to using this industrial by-product as a reusable resource.

Fly ash has been widely used in municipal construction, civil engineering, and other fields; however, there are still great demands in the development of the following technologies and products:

- High-strength concrete
- Hollow-sinter brick
- Blocks with cavities
- High-strength construction materials

Comprehensive Utilization of Domestic Waste

China generates about 136.4 million tons of municipal waste annually, indicating a large potential for comprehensive waste disposal facilities and waste utilization in China.

The three primary disposal methods used in China are landfilling, composting, and incineration; of these, landfilling is the most common. These three methods account for approximately 92 percent, 6 percent, and 2 percent, respectively, of domestic wastes disposed in Beijing. The government of Beijing is attempting to decrease its reliance on landfilling and plans to adjust the current ratios to 4:3:3 by 2008. Landfills create several problems because they require significant areas of land, use resources inefficiently, and result in short- and long-term air and water pollution. The negative effects caused by landfills have encouraged decision-makers to improve compost and incineration facilities in China and to improve resource reclamation and utilization. Drawing on the lead example set by Beijing, it is anticipated that compost equipment, waste incineration and heat recovery equipment, and waste power plants for large- or medium-sized cities will be in considerable demand in China in the near future. In addition, the construction of municipal waste disposal facilities is expected to grow during this period as China generates more and more domestic waste as the economy grows.

CP Technologies Recommended by the Chinese Government

To promote cleaner production and environmental protection in China, the Chinese government enacted technology development requirements for many industries. In addition to these requirements, the former State Economic and Trade Commission published two CP technology guideline directories[4] for priority industries. One hundred thirteen technology issues have been issued for nine industries, including the metallurgy, petrochemical, chemical, light, textile, mechanical, non-ferrous, oil, and construction material indus-

tries. It is recommended that these technologies be applied in relevant industries to help achieve water, energy, and raw material conservation; resource comprehensive utilization; air, water, and solid waste pollution control; and sustainable development in these industrial sectors. The main requirements for the coal, power, metallurgy, chemical/petrochemical, construction material, pulp and paper, and textile industries are described below:

- **Coal Industry:** The goal is to promote clean coal utilization technologies for coal selection and washing, model coal, water-coal-slurry, coal gasification and liquefaction, and the exploitation of coal gas.
- **Power Industry:** SO_2 reduction is the key development directive.
- **Metallurgy Industry:** The goal is to promote technical innovation focusing on CP, coke dry quenching, external refining, high-efficiency continuous casting, and other advanced technologies. Further, the government wants to promote energy; heat and pressure recovery; and comprehensive utilization of waste gas, water, and solid wastes.
- **Construction Material Industry:** The goal is to encourage the future development of new types of predecomposing drying kilns.
- **Chemical/Petrochemical Industry:** The goal is to develop new energy-saving and environmental protection technologies, including heat pipe, heat pump, hydrogen storage, new-type oxidation, high-efficiency pretreatment, and high-efficiency biological treatment technologies.
- **Pulp and Paper Industry:** The goal is to develop or consummate oxygen delignification, non-chlorine bleach, high gain-rate and second fiber utilization, condensation water reuse, and middle concentration screening technologies. Further, the government wants to popularize black liquor distillation equipment, middle concentration operations, water loop circulation, white water recycling, and alkali recovery technologies.
- **Textile Industry:** The goal is to develop and improve supercritical carbon monoxide dyeing, bio-enzyme treatment, natural fiber transfer printing, and non-plate ink jet printing. Further, the government wants to promote cold pad batch dyeing for the pretreatment of cotton fabrics, countercurrent flow bleaching and washing, synthetic fiber transfer printing, and photo-catalytic oxidation color removal technologies.

CP Policy, Technology, and Information Service

Small and privately owned companies are major CP users; however, information related to CP is still inaccessible for many of these firms. The information needed by these companies includes available financial resources, preferential government policies, and appropriate technical information.

The Chinese government has enacted preferential tax policies to encourage the implementation of CP by companies in China. Some financing channels are available for enterprises interested in CP, including state bonds, loans from commercial banks, grants, and special funds for CP companies and activities. Although a number of cleaner production technologies and equipment have been developed globally, they have not been widely adopted in China.

Undoubtedly, the information in the fields discussed here has great value for those firms hampered by a shortage of capital and information. It is expected that with the further development of CP in China, information services will represent a growing market trend in the near future.

Energy Efficiency and P2 Projects Requiring Foreign Investment

China requires considerable investment in energy efficiency and pollution prevention projects. These projects are generally in the cement, power and energy, chemical, pulp and paper, textile, metallurgy, and food industries. They include comprehensive resource utilization, technical upgrades, and eco-industrial park construction projects. Great demand has emerged in gangue and

fly ash utilization and regional co-generation projects. Projects requiring increased investment and cooperation are detailed in Appendix 1.

The main business strategies for foreign investment to enter this market include build-operate-transfer (BOT), joint ventures, and cooperative projects. Most projects are under the management of local companies, with a limited number associated with government agencies.

Foreign investors must be aware of the potential investment risk brought about by China's policy system. Currently, there are no mandatory CP/P2 requirements and no credible support from specific laws. For example, China has not enacted BOT laws and regulations, although BOT has been widely applied in China. Policy directives can be changed easily, and any variation in governmental policies will be converted into risk for foreign investors. To avoid these risks, close attention must be paid to investment contracts and return-on-investment terms.

NOTES

1. China, National Development and Reform Commission, *Cleaner Production Technology Guideline for Priority Industries* (Beijing: State Economic and Trade Commission, 2003). English abstract available at *www.chinacp.can/eng/cptools/cpt_book10.htm*.

2. Ibid.

3. China, Ministry of Science and Technology, *List of Advanced Technologies and Equipment Encouraging Foreign Investment* (Beijing, 2003).

4. *Cleaner Production Technology Guidelines*, op cit.

CHAPTER 3

Competitive Situation

Domestic Production

Brief Background on the Environmental Protection Industry

The environmental protection industry in China is growing rapidly. By the end of 2000, there were more than 10,000 environmental companies and organizations. Of these, more than 8,500 were companies, and approximately 1,500 were organizations such as research institutes. The total production value of the environmental industry for 2000 was US$13 billion. The output value of environmental products, resource comprehensive utilization, and environmental services were US$30 billion, US$68 billion, and US$1.2 billion, respectively, representing approximately 28 percent, 63 percent, and 9 percent of the total industry.

Although the Chinese environmental industry has grown significantly in the past 10 years, several issues of concern have emerged. First, small companies represent more than 90 percent of the total firms, thus making economies of scale difficult to achieve. Second, the geographical distribution of environmental enterprises is unbalanced, with most of the firms located in the more developed southeastern areas of the country. Third, the environmental companies are primarily associated with environmental products and equipment, and very few have the capacity to provide advanced techniques and consultant services. Fourth, the technical level of these companies lags behind international standards, with the overall level of the environmental technology equivalent to that of developed countries in the 1980s.

CP technology alternatives are provided and promoted through the environmental service sector, which includes environmental technology, consulting, waste disposal facility management, waste recycling, and trade and financial services. According to the Chinese Association of Environmental Protection Industry (CAEPI), the most active research is focused on the development of the CP technologies for the treatment of wastewater and waste gas. Also, compared with research institutes, most environmental firms have relatively weak technical development and research capabilities and limited investment on research.

The consulting audit and technology service providers for CP are the 46 companies that have completed CP audits for demonstration models. SEPA has requested that these firms compile the CP technique requirements and recommendations in several industries. To date, they have prepared draft CP audit guidelines and technical requirements for about 16 industries. SEPA hopes to promote the use of these 46 firms and is encouraging them to become more active in the CP industry in China.

Special Technologies in *Cleaner Production Technology Guideline Directory for National Priority Enterprises* and CP Audits

There has not been a comprehensive and integrated system for CP advancement in China. In the absence of an overall strategy, domestic CP information has been provided in two ways: the *CP Technology Guidelines Directory for the National Priority Enterprises*[1] and technical services from the Cleaner Production Center.

As described in Chapter 2, the *CP Technology Guideline Directory for the National Priority Enterprises* listed 113 CP techniques recommended by the government. In relation to the listed techniques, most of the companies or institutions with the capacity to provide the associated technologies are domestic companies, including the Cleaner Production Center, CP demonstration companies, research institutes, and some environmental consultants. The recommended techniques are summarized below.[2]

Metallurgy Industry

CP techniques are as follows:

- Dry-quenching using air—coke industry
- Injection of pulverized coal—blast furnaces
- Use of small pellets in sintering
- Recovery of waste heat from cooling equipment
- Electrostatic dust collection—sintering process
- Desulfurization of coke oven gas
- Recovery of liquid CO_2 from waste gas
- Reconcentration of tailings to produce fine iron ore
- Bag collection of dust from blast furnace gas
- Gas purification and recovery—Lurgi and Thyssen processes
- Use of coal dust in briquette manufacture
- Powder production
- Use of blast furnace gas as sole source fuel in boilers

Petrochemical Industry

CP techniques are as follows:

- Ammonia recovery from sulfurous effluent
- Direct entry of polyethylene liquid into distillation tower
- Ammonia removal from sulfurous effluent
- Recovery of purified water
- Automatic water removal in oil storage tanks
- Flare gas recovery
- Removal of sulfur by absorption
- Treatment of solid waste in oil refineries
- Blast aeration
- Cooling process in phthalic acid plant

Chemical Industry

CP techniques are as follows:

- Decontamination of feed gas in synthetic ammonia production—methanol and methyl oxide process
- Decontamination of gas in synthetic ammonia production
- Natural gas conversion by heat exchanger
- Synthetic gas makeup by pressure gasification
- Recycling of effluent from phosphoric acid process
- Integrated process for producing phosphoric acid and cement from phosphogypsum
- Power generation by using high- and middle-temperature waste heat from sulfuric acid process
- Integrated process for producing chlorylene and perchloroethylene
- Calcium chloride and sodium chloride production from ammonia still effluent
- Hydrogen peroxide production by using fixed bed palladium catalyst

Light Industry

CP techniques are as follows:

- Alkali recovery from black liquor—soda/kraft pulping
- White water recovery with air jet flotation—paper manufacture
- White water purification using vacuum filtration
- Air flotation cells
- Dried protein production—corn wine stillage
- Differential pressure distillation
- Wine stillage treatment by anaerobic–aerobic process
- Raw skin preservation using saturated brine

- Direct utilization by adding chrome-tanned liquid waste into fresh tan liquid
- Beer yeast recovery and comprehensive utilization
- Production of high protein, glutamic acid, and compound fertilizers

Textile Industry

CP techniques are as follows:

- Transfer printing
- Recovery of dyes by ultrafiltration
- Dyeing with environmentally friendly dyes
- Printing with environmentally friendly inks
- One-step process for bleaching of cotton fabric
- Enzyme use for washed denim
- Diluted alkali recovery in cotton polishing
- Infrared directional radiator
- Enzymatic desizing
- Recovery of waste steam from boiler—viscose fiber mill
- Use of more efficient and active dyes
- Salvage of wool grease from wool washing effluent
- Waste alkali recovery in polyester dyeing and printing process

Typical Technologies in Energy Efficiency and P2

Energy Efficiency

The Energy Conservation Information Dissemination Center (ECIDC) is the major provider and consulting organization in China for technical services in energy efficiency. The former State Economic and Trade Center directly supervised the ECIDC. The ECIDC's main function includes (1) selecting and promoting best energy efficiency models and examples and technical research and systematic energy efficiency plans and (2) establishing energy efficiency databases to provide information services. Services provided by the center are mainly focused on the high-energy consumption industries, including the metal, construction material, chemical engineering, power, and paper industries. ECIDC promotes 40 new energy efficiency technologies, including heating, cooling, power cogeneration by lithium bromide, and boiler energy saving technique.

China has established three demonstration energy management companies (EMCs). The World Bank/Global Environmental Facility–China Energy Conservation Project was started in 1996 to introduce, demonstrate, and implement an energy conservation project financing concept, or Energy Performance Contracting (EPC). The project also sought to establish market-oriented mechanisms to promote and implement energy efficiency measures in China. In Phase I of the project, three demonstration EMCs were established in Beijing, Liaoning, and Shandong. The demonstration projects involved the following companies: the Beijing Yuanshen Energy Saving Technology Ltd., Liaoning Province Energy Conservation Technology Development Co., and the Shandong Energy-Saving Engineering Co., Ltd.

The following year, EMCs were established in other provinces in China. In January 2002, the first EMC, Hubei Mei Ou Energy Efficiency and Environmental Protection Engineering Co., Ltd., was established. The Shanghai EPC Instructive Committee was founded in October 2002; at the same time, the first EMC in Shanghai, the Shanghai Energy Efficiency Service Co., Ltd., also was established. Shanghai held an international workshop on EPCs in September 2003 and prepared its EPC development plan for 2003 to 2005. Approximately 36 demonstration EPC projects will be conducted in 10 industries in Shanghai during this period.

In the last five years, the three demonstration EMCs in Beijing, Liaoning, and Shandong have conducted 208 energy efficiency technology innovation projects. The total assets of the three companies has increased from US$8.9 million to US$38 million during this period.

Desulfurization Technology and Equipment

Desulfurization technology and equipment is widely used in industrial boiler and power plants. Currently, the desulfurization technologies for coal-fired boilers with a capacity less than 10 tons/hour are generally simple wet desulfurization with a desulfurization efficiency of about 30 percent to 50 percent. Vermiculite–water film desulfur-

ization is used for most coal-fired boilers with a capacity of more than 10 tons/hour and has an efficiency of about 30 percent to 60 percent. China has conducted research on wet desulfurization and dedusting techniques and equipment, which has resulted in the creation of five control equipment models and other desulfurization techniques.

Currently, the total capacity of power plants with flue gas desulfurization (FGD) equipment is 5,105 MW, which represents about 2 percent of the total national power plant capacity. According to information from CAEPI, China does not have the capacity to design and construct the efficient FGD equipment for power units with a capacity greater than 200 MW. Although demonstration projects of FGD for 300 MW power units are under construction, the technologies are still in the commissioning and testing stages. There are six major FGD companies in China that focus on providing both FGD equipment and project design and implementation, including the following:

- Longyuan Environmental Co.
- Zhejiang Feida Co.
- Longking Environmental Co., Ltd.
- Wuhan Kaidi Electric Power Co., Ltd.
- Chongqing Jiulong Electric Power Co., Ltd.
- Tsinghua Tongfang

The first five firms are importing techniques from or cooperating with international companies, while also developing their own equipment. Only Tsinghua Tongfang has developed all of its own techniques. The Longyuan Environmental Co. is the strongest in terms of technical expertise and capacity to develop the market.

Dedusting Technology and Equipment

Currently, electrostatic precipitators and bag filters are the most efficient types of dedusting equipment used in China. There are 13 suitable electrostatic precipitator production factories in China that service the mechanical, metal, power, chemistry, and construction materials industries. According to statistics provided by CAEPI, combined sales for these firms was US$226 million, representing 78 percent of the industry's total sales. From a technical perspective, companies offering products to the cement industry are strongest because they are using more advanced technologies.

There are numerous (approximately 500) bag filter manufacturers. However, only about 10 of these firms have CP development potential. In 2000, the production value of all the manufacturers was US$214 million. Technical innovation in the manufacturing of bag filters is improving in China with the importation of new technologies. However, most firms still lack adequate technical development facilities.

Comprehensive Utilization of Gangue

In China, gangue is mainly used for power generation fuel and construction materials. In 2000, the total amount of gangue used in these industries was 66 million tons—10 million tons more than that in 1995. By the end of 2000, 120 power plants were using gangue as fuel, with a combined capacity of 1,840 MW and electricity-generating capacity of 8.7 billion KWh/year. Gangue also is used to produce new construction materials, such as bricks. There were more than 240 gangue brick factories by the end of 2000, with a capacity of 2.2 billion standard bricks per year. In the ninth five-year plan, 10 new product lines for gangue bricks were established, with an annual capacity of 600 million bricks.

The technical level for comprehensive gangue utilization has improved significantly as a result of the ninth five-year plan in 2000. In the area of gangue power generation, the CFB boiler of 35 tons/hour has been widely used, and a 75 tons/hour model has been finalized. The Yongrong Mining Bureau, Zhejiang University, and China National Coal Comprehensive Utilization Group Corporation have cooperated to develop the CFB using gangue and coal slurry as fuel. In addition, gangue brick manufacturing technology in China has reached international levels. High-value technologies using gangue also have developed significantly during this period, including using gangue to produce super-fine kaolin and using gangue as a supporting medium to produce inorganic ferti lizers.

Domestic use of gangue is increasing significantly in China, but the overall technical level in industries as a whole is still relatively low. Less than 20 percent of all technology used by Chinese companies is at the level of comparable 1990s-era tech-

nology used by developed countries. Domestic gangue utilization firms are generally small scale, and the average production capacity of gangue brickfields is less than 10 million pieces/year. In addition, the utilization rate is quite variable across the country, with higher rates in regions with energy shortages as opposed to regions rich in energy resources. For example, the comprehensive utilization rate of gangue in East China and Southwest China is normally more than 60 percent, more than 18 percent higher than the national average. Limited access to preferential government policies and loans from commercial banks is the major obstacle limiting domestic producers from developing their businesses further.

Comprehensive Utilization of Fly Ash

China has been conducting research on the comprehensive utilization of fly ash since the 1950s. Fly ash can be used in building material production, road construction, fertilizer production, melioration, and backfilling. In Shanghai, Nanjing, Nantong, and Nanchang cities, the fly ash comprehensive utilization rate has reached 100 percent continuously for several years. In Harbin City, the fly ash comprehensive utilization rate increased from 50 percent to 90 percent in 2003. Despite these recent efficiencies, the quantity of fly ash used is relatively low in comparison with that of developed countries.

Renewable/Clean Energy

As a rising technology, new energy and renewable energy in China have the combined problem of low commercialization and an immature market. Technologies for solar water heaters in China have been well developed for the past 20 years. By 1998, the amount of solar water heating panels was 15 million m^2, representing the highest capacity in the world. China's annual production capacity reached 4 million m^2, with a value of more than US$423 million.

In 1998, the total production capacity of solar batteries in the country was 45 MW, but almost all production lines were imported. The domestic technical level and pricing is not competitive with that of developed countries.

Large-scale wind power also has developed rapidly, and by the end of 2002, there were nearly 30 wind farms with a capacity of 444.405 MW throughout the country. Almost all large-scale wind power generators are imported from foreign countries; however, domestic technology for small-scale wind power is relatively good. Chinese firms are capable of manufacturing 10 types of wind power generators ranging from 100 W to 10 kW in size. Domestic small-scale wind power generators have the advantages of low start-up wind speed, reliable speed control, and low production costs and market prices compared with foreign manufacturers; however, they suffer from low quality appearance and low technical levels in blade materials and manufacturing technology.

Current Status of CP Technical Level in China

Like most conventional environmental technologies, the technical level of CP technology in China is still far behind that of developed countries. Considering the wide range of industries in which CP technologies can be applied, it will take considerable time to fully develop and use CP technologies in the many industries in China. Current efforts to promote CP technology in China are focused on major polluting industries and heavily affected areas. Because of this prioritized approach, there are large differences in CP application levels between industries and in different regions of the country.

Third Country Competition

Currently, third countries have provided no comprehensive statistics on CP technology that they provide in China. In general, Japanese companies have advantages in air pollution prevention technologies, whereas German, French, and Italian firms have advantages in waste pollution prevention and control technologies.

In the first batch of the *Cleaner Production Technology Guideline Directory for National Priority Enterprises*,[3] three techniques of the 57 technologies were developed by foreign countries. These techniques are recovery of waste heat from sintering condensers by Sumitomo Metal Mining Co., Ltd., converter gas purification and recovery by the Lurgi Thyssen process, and technology for using coal dust in briquette manufacture by the Lurgi

Thyssen process provided by Lurgi (Germany) and VAI (Austria).

Some third countries have helped to introduce CP technologies of their own to China through cooperative projects. For example, the China–Canada CP project included demonstrating CP technologies by providing CP technology and equipment. A cooperative project between Germany and the Dongying City EPB also has introduced cleaner production technology to industries in the project area.

In the FGD field, Japanese and European companies have made efforts to introduce their technology and equipment to China. The major players are Japan, Germany, and Denmark. There have been approximately 10 sets of FGD equipment imported from Japan since the 1980s, representing 70 percent of the total amount imported. In 2003, the desulfurization project for the Yangzhou Power Generation Company Co., Ltd., was put into use, which was constructed cooperatively by the Chinese and Japanese governments with an investment of US$18 million. ABB (Sweden), WULL (Germany), and Mitsubishi Heavy Industries (Japan) also have cooperated to some extent with Chinese environmental companies to introduce their desulfurization technologies.

U.S. Market Position

Considering the U.S. market position in the environmental technologies, "American firms have lagged behind their competitors despite China's high regard for U.S. technology."[4] In addition, it is reported that technologies and equipment from the United States are relatively more expensive than domestic products, which makes U.S. technologies less competitive in the Chinese market.

There are a few examples of cooperative projects between Chinese and U.S. companies/institutions on CP technologies. For example, General Electric has cooperated with a Chinese environmental company, Longking Environmental Co., Ltd., to provide its desulfurization techniques. Another U.S. company, Environmental Element Corporation, has introduced its dedusting technologies to China through the coal boiler technology transfer subprojects of the GEF-founded project, Efficient Industrial Boilers. It has established a subsidiary company in China—Enelco Environmental Technology (Anhui) Co., Ltd. In addition, Iowa State University has helped the Henan Provincial Gangue Engineering Technology Research Center to develop utilization technologies for a comprehensive utilization of gangue.

The U.S. government and U.S. companies have introduced U.S. CP technologies in China through seminars and workshops. For example, at the Sino–U.S. Workshop on Zero Discharge of Industrial Waste Water held by the former State Economic and Trade Commission and the U.S. Department of Commerce in 2002, Resources Conservation Company International introduced technology on the use and zero discharge of industrial wastewater. In addition, Cummins Inc., with other companies, helped stakeholders in the Shanghai energy efficiency community understand how the energy service and management sector functions in the United States at the International Workshop on EMCs in Shanghai in 2003.

The U.S. Environmental Protection Agency and the Chinese government conducted the "Promotion of International Pollution Prevention Technology in China" project from 1995 to 1996. The purpose of the project was to promote pollution practices and to provide export opportunities for U.S. environmental service and technology providers. The project covered awareness raising, training, workshops, demonstrations, evaluations, and the promotion of P2 and CP in three industrial sectors (the pharmaceutical, petrochemical, and metal-finishing industries) and included a review of six pilot tests. Throughout the project, CP assessments were conducted in the six companies, and 57 "zero" cost and low-cost CP options were implemented. CP guidelines for the pharmaceutical, petrochemical, and metal-finishing sectors also were developed.

End-User Analysis

Municipal and Governmental End-Users

The strongest growth in the municipal and government end-user market will be for management and technical services for local governments developing eco-industrial parks. Also, the provi-

sions in the CPPL that require priority purchases for CP products by the government also will increase the demand from these users.

Chinese authorities regard eco-industrial parks as an effective win–win approach to promoting economic and environmental strategies. Local authorities, in cooperation with academic institutions, initiated several eco-industrial parks projects. Since 1999, the Tsinghua University has helped conduct three eco-industrial parks projects in different regions of the country:

- The Zaozhuang Eco-Industrial Parks Initiative in Shandong Province in Northern China transformed a traditional industrial zone into an eco-industrial park.
- The Quzhou Eco-Industrial Parks Initiative in Zhejiang Province in Eastern China included constructing a matrix of material exchanges among dozens of chemical plants.
- The Nanhai Eco-Industrial Parks Initiative in Guangdong Province in Southern China was designed to develop the environmental protection industry in a greenfield site.

SEPA has been reported to have approved the establishment of five eco-industry parks in some cities as pilot projects for the recycling industry. The state eco-industry demo parks listed are North Shandong Demo Park in Shandong Province, Changsha Huangxing Demo Park in Hubei Province, Baotou Demo Park in Inner Mongolia, Guigang Demo Park in Guangxi Province, and Nanhai Demo Park in Guangdong Province. Guiyang city in Guizhou Province has been specifically selected as the pilot city for the "recycling economy." It is estimated that eco-industrial parks will be developed progressively in the coming years in China.

As required in CPPL, the CP information and technology consulting and service system should be established to provide methodology and technical information related to CP. The goal of this system is to encourage the use of renewable and recyclable waste products and the implementation of CP policies. The CP technical consulting and services system should include training, information collection and distribution, technology research and promotion, and CP audits. Although there are many institutions (for example, CP centers in different areas) working in the CP technology consulting and service sector, consulting and service organizations cannot meet the great demand for CP technology. The Chinese government will try to encourage the growth of professional CP consulting and service organizations to meet demand.

CP products have priority in government purchasing. Article 16 of the CPPL prescribed, "Governments at all levels shall give priority to purchase products conducive to energy and water conservation, waste reuse, environmental protection and resource conservation."[5] The list of environmental protection equipment encouraged by the government also states that the listed products and technologies shall be given priority in governmental purchasing procedures. In 2002, the government's purchasing budget was US$12 billion, of which local government spent US$9.6 billion and the central government spent US$2.66 billion. The amount for environmental and landscaping projects was US$203 million, which indicates various levels of government have commitments to spend on CP-produced products and represents another large market for manufacturers and service providers.

Industrial End-Users

From an environmental perspective, almost all industries in China require CP technology to mitigate the serious pollution situation in the country. However, only profitable companies can afford to apply CP techniques.

The CPPL requires companies that do not comply with the national or local discharge standards, or do not comply with the mass load control targets for pollutants set by the relevant local governments, to conduct CP audits. Normally, the CP audit implementation schemes will suggest applying technical innovations or applying CP technologies in these non-compliant polluting firms. Unfortunately, many of these heavy polluters are in relatively poor financial shape and lack financial resources to implement CP upgrades.

Because of the huge differences among different types of enterprises in China, potential industrial end-users will be discussed in the following separate sections.

State-Owned Companies

In the demonstration enterprises, there are quite a few big group state-owned companies such as the China National Petroleum Corporation, China Petroleum and Chemical Corporation (Sinopec Corp.), Shanghai Baosteel Group Corporation, and Anshan Iron and Steel Group Corporation. These companies are profitable and are capable of securing support from the government in investment and policy. These profitable companies have CP requirements and have the ability to conduct CP-related technical innovations. Unfortunately, most state-owned enterprises have financial problems and cannot afford the costs to implement CP practices to reduce their pollution levels.

Private Companies

In the developed areas of the southeast provinces in China, large local private companies have had increased demand for CP products and services in the past few years. These companies understand the benefit that energy efficiency and P2 provides, and they have the money to invest in applying CP technologies.

Another large potential source of end-users for CP are county- and village-owned companies. These companies are generally in early startup stages of their development, with low-level technology, high-energy consumption, and heavy pollutant discharges. In addition, the managers of these companies lack a good understanding of pollution issues and are indifferent about applying CP technologies.

Conclusion

There are both government and industrial sector CP end-users in China, with a big market demand for CP technology, equipment, and services. However, it is important for investors to recognize that CP in China is, to some extent, a government initiative and policy-driven market. Company senior managers generally lack the awareness or desire to promote CP technologies in their business management plans. This will undoubtedly hamper the growth of the CP market, creating risk for CP related technology and equipment export and investment in China.

NOTES

1. *CP Technology Guideline Directory for the National Priority Enterprises.*

2. Note that these examples are taken from an original text where only the heading of the associated technical work was provided in English. The original full texts are only available in Chinese.

3. *Cleaner Production Technology Guideline Directory for National Priority Industries* (Phase I), Resource Saving and Comprehensive Utilization Department of the State Economic and Trade Commission, September 2000.

4. "Contact China 2003" by U.S. Commercial Service Offices in China.

5. CPPL, Article 16, issued by the National People's Congress of the People's Republic of China, effective from April 1, 2002.

CHAPTER 4

Market Access

Import Climate

China WTO Accession

China's WTO accession presents the latest opportunity to promote the entry of foreign products into the Chinese market. CP technology and equipment are classified in the WTO's mechanical industry sector, and, therefore, China's WTO commitments are applicable for the import of CP technology and equipment. Table 4.1 details some of these commitments.

The arithmetic average import tariff rate was 13.7 percent for mechanical products in 2000. Currently, the actual tariff rate has been reduced to less than 10 percent in China as a result of the implementation of tariff reduction policies. This already low tariff means that many imported general mechanical products will not be affected greatly by further reductions in the tariff, and domestic products will retain their price advantages for the next couple of years.

Key imported equipment and high-tech products, such as supercritical thermal power units, CFB boilers, and other advanced and high-efficiency generators (which may be considered as CP equipment), will present great challenges for domestic products. The technical level of most domestic equipment in this field is far behind that of imported products and will have difficulty meeting China's increasingly stricter requirements for energy and resource efficiency and P2. With the opening of the technology and equipment import market and the cancelation of protective policies for domestic products, the market share of imported technology and equipment will undoubtedly increase, especially for those with high technical content and added value.

Government Measures to Encourage or Restrict the Import of CP Technology

The Chinese government has enacted three laws or policies to encourage and guide foreign participation in China's cleaner production sector:

- The **Cleaner Production Promotion Law** (CPPL) was approved by the Standing Committee of the National People's Congress of the People's Republic of China, and became effective January 1, 2003. According to Article 6 of this law, China should encourage scientific research, technical development, and international cooperation to develop CP and to share information with respect to CP to promote CP technologies.
- The **Prescription on Guiding Foreign Investment Directions** was approved by the state council and became effective April 1, 2002. According to this policy, foreign investment projects are classified as either encouraged, permitted, restricted, or prohibited. CP-related projects that are encouraged by this policy are in the fields of new technology and equipment, energy and raw materials conservation, resource comprehensive utilization, renewable resources, and P2. Projects restricted by this policy include those with antiquated technology or inefficient resource use. These projects are detailed in the *Foreign Investment Industry Guideline Directory*,[1] described in the next section.

Table 4.1
China's WTO Commitments Related to Mechanical industry

Measure	Commitment
Reduce tariff	• For mechanical products, the arithmetic average import tariff rate will be reduced to 10 percent five years after WTO accession.
Cancel non-tariff measure	• Non-tariff measures, such as import quotas and permits, will be canceled in 2005.
Open trading field	• Authorization for both import/export and domestic businesses in the trading field will be opened three years after WTO accession. • The restrictions on the location, quantity, and shareholding proportion of foreign enterprises will be canceled gradually.
Adjust the policies on foreign investment, and technical absorption and local production	• The requirements for foreign exchange balance, actual export achievements, proportion of local production, and technical transfer will be eliminated. • The requirements for the percentage of local production in joint venture projects will be eliminated.

- The **Foreign Investment Industry Guideline Directory** was approved by the state council, and became effective April 1, 2002. In this policy, the encouraged and restricted industries related to CP for foreign investors are listed. Some details are provided in Table 4.2.

Encouraged industries in the directory receive preferential treatment stipulated in relevant laws and administrative regulations, such as exemptions from import tariffs and value-added taxes.

Business Practices and Options

Foreign companies have several avenues to enter China's cleaner production technology and equipment and investment market, some of which are discussed in the following sections.

CP Technology and Equipment Sales

Technology and Equipment Exports

This is the most readily accessible mode for foreign companies to enter the Chinese market, and long term, there is lower risk in the export business. Most export opportunities arise from international bidding on multilateral loan projects or as appointed purchasers of bilateral loan projects. The end-users are generally large-sized public utilities such as the energy solar development project in the Xinjiang Uighur Autonomous Region, which is funded by the Dutch government.

Trading Companies

Generally, foreign companies are not permitted to trade directly in China. The exception is to include some domestic manufacturing component or to establish a wholly owned foreign trading company in a free trade zone with limited access to markets outside these zones. Accordingly, foreign exporters need to establish a joint venture trading company in which the exporter can be the majority shareholder or use a Chinese agent for both importing and marketing in China. The trading company must be authorized by the central or provincial government to manage imports and exports and to sign contracts.

Local Agents

In addition to trading companies, many sales agents handle domestic distribution and marketing. Most of these firms do not have import/export authorization; however, they buy imported products from those firms with authorization. They may be representative offices of foreign trading companies or Chinese firms with regional or national networks. Beijing, Shanghai, and Guangzhou are the most likely entry points given their geographic and economic roles in China.

Table 4.2
Selected Encouraged and Restricted CP-Related Industries

Encouraged Industry	
Mining production and manufacturing	• Coal bed gas exploration and exploitation • Comprehensive utilization, treatment, and disposal of waste gas, liquid, and solids in chemical raw material and chemical production • Recycling and reuse of used plastic in the plastic industry • Cement production with new types of drying kilns above 2,000 tons/day in nonmetal mineral production (restricted in the middle and western regions of China) • Desulfurization technology and equipment fabrication for thermal power plants • Fabrication of thermal power equipment, such as supercritical generators with a capacity of 600,000 kW and above (restricted in joint venture and cooperation) • Development and use of clean coal technology and equipment (coal gasification and liquefaction, water coal slurry, industrial model coal) • Coal washing and selection and comprehensive use of fly ash and gangue
Production and supply of power and coal gas	• Construction and operation of coal-fired power plants using clean combustion technology • Construction and operation of cogeneration power plants • Construction and operation of renewable energy power plants (including solar, wind, tidal, and others)
Services	• Construction and operation of wastewater and domestic waste treatment plants, hazardous waste treatment and disposal facilities, and other environmental pollution treatment facilities • Consultation service for international economy, science and technology, and environmental protection information
Scientific research and comprehensive technical service	• Energy-saving technology development • Resource recovery and comprehensive utilization technology • Environmental pollution treatment technology
Restricted Industry	
Services	• The construction and operation of gas and heat networks in large and middle-sized cities (except where the Chinese investor holds the joint-stock company)

Representative Offices

Representative offices are the easiest type of offices for foreign firms to establish in China. According to Chinese law, these offices can perform only tasks such as "liaison" activities. As such, they cannot sign sales contracts or directly bill customers or supply parts and after-sales services for a fee, although most representative offices perform these activities in the name of their parent companies. Establishing a representative office gives a company increased control over the sales and permits greater use of its specialized technical expertise.

Chinese Subsidiaries

A locally incorporated equity or cooperative joint venture with one or more Chinese partners, or a wholly foreign-owned enterprise, may be the next step in developing a market for a company's product. Domestic production can avoid import restrictions—including tariffs—and can provide foreign firms with greater control over both intellectual property and marketing.

Investment

Investment demand exists for technology and equipment in the area of CP, especially the construction and operation of large-sized public utilities such as cogeneration power plants, domestic waste incineration, and power-generating facilities. BOT, joint venture, and cooperation options are quite viable options, although they have not been widely exploited in China. It is believed that with

the further development of cleaner production in China, more and more investment opportunities will emerge in new energy development and use, waste reclamation and reuse, resource comprehensive utilization, and any other CP-related sectors.

Foreign Private Sector Involvement in CP-Related Technology and Equipment

All of the product sales and investment methods described in the previous section are suitable for foreign private companies. Because manufacturing is the dominant industry in China, a large market demand for CP technology and equipment exists at the base level of China's economy. Based on this, "product sales" represents the primary opportunity for foreign private companies looking to take advantage of China's drive to CP practices.

Foreign companies with ambitions to develop their business in China should recognize that government policies and regulations will have a significant impact on the development of CP market demand in China. For instance, the new SO_2 discharge levy policy has triggered huge demand for desulfurization equipment. Foreign investors can look to proposed or impending legislation to forecast potential markets and identify future business opportunities.

Foreign private companies enjoy an advanced level of technology that allows them to compete with local manufacturers; however, proper local technical training and after-sales service must be provided to maintain market share.

Financing

U.S. Government Resources

U.S. firms can use the U.S. government resources discussed in the following sections to facilitate their investment in China:

Export-Import Bank of the United States

The Export-Import Bank of the United States (Ex-Im Bank) is the official export credit agency of the United States. The Ex-Im Bank's mission is to assist in financing the export of U.S. goods and services to international markets. The Ex-Im Bank provides working capital guarantees (preexport financing), export credit insurance (postexport financing), and loan guarantees and direct loans (buyer financing) for large and small enterprises; it also enables them to turn export opportunities into real sales.

Ex-Im Bank now accepts guarantees from three Chinese financial institutions: the Bank of China, the People's Construction Bank of China, and the Industrial and Commercial Bank of China.

Listed below is the address for headquarters of the Ex-Im Bank:

811 Vermont Avenue, N.W.
Washington, DC 20571
Tel: (202) 565-3946 or (800) 565-3946

U.S. Trade and Development Agency

The U.S. Trade and Development Agency (TDA) is an independent U.S. government agency that provides grant funding for studies to determine the technical, economic, and financial feasibility of major infrastructure and industrial projects in developing and middle income countries. TDA funds U.S. company feasibility studies on projects that have the potential to generate significant exports of U.S. goods and services. By providing assistance in project planning, TDA promotes economic development while helping the U.S. private sector get involved in projects that offer significant U.S. export opportunities.

Energy efficiency and pollution prevention are TDA priorities for China. Since 2001, TDA-funded projects related to these sectors have included Ningxia Di-Methyl Ether Plant Project, PetroChina Enhanced Oil Recovery Project, Geothermal Heat Pump Project, and Shenhua Direct Coal Liquefaction Project.

The address for TDA headquarters is:

1000 Wilson Boulevard, Suite 1600
Arlington, VA 22209
Tel: (703) 875-4357
Fax: (703) 875-4009
E-mail: *info@tda.gov*

U.S. Small Business Administration

The U.S. Small Business Administration encourages private lenders to make loans of up to US$750,000 to borrowers who could not borrow on reasonable terms without government help.

The address for the U.S. Small Business Administration is :

409 Third Street, S.W.
Washington, DC 20416
Tel: 1-800-U-ASK-SBA
Web: *www.sba.gov*

Multilateral and Bilateral Lending Programs

The development of China's CP has received great support from multilateral and bilateral partners in both capital and technical aids. In the fields of energy efficiency, resource utilization, and P2, multilateral loans have provided continuous lending support.

The World Bank

China is the World Bank's largest borrower. The total loans for China's P2 and pollution control currently stand at US$2 billion. From 2002 to 2004, there was approximately US$1.2–1.3 billion in lending annually. Transport and urban environmental mitigation are two priority sectors, accounting for nearly 60 percent of the total loans. The energy sector, with a focus on renewable and efficiency objectives, accounts for 7 percent of the total loans. These loans are more likely to be supported by GEF assistance than with International Bank for Reconstruction and Development lending. Generally, only government activities are awarded World Bank loans; that is, the loans are not available to the private sector.

The contact information for the World Bank is as follows:

Ms. Li Li
The World Bank Resident Mission in China
9th Floor, Building A, Fuhua Mansion
No. 8, Chaoyangmen Beidajie
Dongcheng District
Beijing 100027 China
Tel: +86-10-6554-3361, ext. 2030
Fax: +86-10-6554-1686
E-mail: *Lli2@worldbank.org*

Asian Development Bank

According to the ADB's operational strategy for the People's Republic of China, the ADB will encourage CP technologies and renewable energy in China. Up to now, the ADB has supported the establishment of environmentally sound technology transfer centers and a CP technology development project. The latter was initiated February 5, 2002, to assess a suitable financing system for China to help enterprises adopt CP technologies.

In the energy sector, loans of US$350 millionwere awarded in 2004, and US$180 million will be awarded in 2006. Also, technical aid projects worth US$1.4 million, US$1.0 million, and US$1.6 million will be awarded in 2004, 2005, and 2006, respectively. These projects will focus on the utilization of coal bed methane.

The ADB supports not only large-scale infrastructure and public utility projects but also small and medium-sized private sector companies. At present, the ADB has supported nine private sector projects in China, including two commercial banks, three investment funds for small and medium enterprises, two power projects, and two water projects.

The contact information for the ADB is as follows:

7th Floor, Block D
Beijing Merchants International Financial Center
156 Fuxingmennei Avenue
Beijing 100031 China
Phone: +86-10-6642-6601 to 6642-6605
Fax: +86 10-6642-6606, 6642-6608
E-mail: adbprcm@adb.org
Web: *www.adb.org/PRC*

Global Environment Facility

GEF is an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities. As of February 2001, China had received grants totaling US$356 million. In the 2003 fiscal year, an ongoing GEF lending program of approximately US$26 million focused on energy saving. The project supports the establishment, pilot testing, and commercial demonstration of market-oriented EMCs that promote investment in energy-efficient technology through energy performance contracting.

In 2004, two loan programs of US$50 million and US$15 million focused on renewable energy and coal gasification projects, respectively. In 2005, a loan program worth US$18 million will focus on heat supply reform and building energy saving.

The contact information for GEF is as follows:
Room 417, 419, Debao Hotel
No. 22 Debao Xin Yuan
Xi Zhi Men Wai Avenue
West District
Beijing 100044 China
Tel: +86-10-6833-4530-6833 or 2294
Fax: +86-10-6833-4531

The Canadian International Development Agency

The Canadian International Development Agency (CIDA) is a department within the Canadian federal government. CIDA's objectives are as follows:

- Facilitate the efforts of people in developing countries to achieve self-sustainable, economic, and social development in accordance with their needs and environment by cooperating with them in developing activities
- Provide humanitarian assistance, thereby contributing to Canada's political and economic interests abroad in promoting social justice, international stability, and long-term relationships for the benefit of the global community

CIDA has financed the China–Canada Cooperation Project in Cleaner Production.

The contact information for CIDA is as follows:

Josée Landry
Regional Program Officer
300 West Georgia Road, Suite 2000
Vancouver, British Columbia
Canada V6B 6E1
Tel: (604) 666-5697
Fax: (604) 666-0954
Web: *www.acdi-cida.gc.ca/index-e.htm*

Other Bilateral Loans

Many other countries, including Australia, the United Kingdom, Germany, Sweden, Holland, Norway, and Japan, provide grants and technical aid to China for the development of CP in China. This aid is intended to promote the national public image of these countries and to help their domestic firms enter the Chinese market; it is not accessible to other countries.

Domestic Financing Resources

Domestic financing channels are generally available only for domestic companies; however, foreign investors or companies may access domestic loans through joint ventures. The main domestic financing channels include state bonds, governmental funding, SDB loans, commercial loans, and listed stock companies.

State Bonds

State bonds are generally awarded to key state projects with a total investment of more than US$12 million. Large-scale industrial technical upgrade projects are a priority area of investment for state bonds. State bonds are one of the primary financing sources for the previously identified 100 demonstration projects on CP, water saving, energy saving, comprehensive resource utilization, and renewable energy development and use to be implemented in China. Forty of these bonds have already been initiated, with a total investment of US$967 million.

Governmental Funding

The Chinese government has established funding for small and medium-sized companies for the implementation of CP in China. This has been mandated in the CPPL, making two kinds of funds available for CP-related activities. These funds are special technological development funds and small and medium-sized enterprise development funds:

- **Special Technological Development Funds**: These funds are set aside by the fiscal management departments of the state council and are coordinated by local people's governments at or above the county level. Special technological development funds will be used to support the following activities: conducting CP research, demonstration projects, training, implementing key national CP technological innovation projects, and implementing individual technological innovation projects listed in the voluntary pollutant reduction agreements.

- **Small and Medium-Sized Enterprise Development Funds:** These funds have been established to support CP for small and medium-sized companies in accordance with their needs.

State Development Bank

Different from a commercial bank, the SDB is a policy bank. An SDB loan generally is for a large amount, is long term, and has a preferentially low interest rate. The total amount of an SDB loan may be several billion RMB Yuan. The priority sectors for loans are state infrastructure projects and industries deemed fundamental to China. SDB loans also have been awarded to industrial technical upgrade and innovation projects.

Commercial Bank

There are four major commercial banks in China. They are the People's Construction Bank of China, Industrial and Commercial Bank of China, Bank of China, and Agriculture Bank of China. Loans from commercial banks are a major source of funding for companies, especially those without access to national financial support. To obtain loans from commercial banks, companies must have sound credit and loan guarantees.

Stock Market

The stock market is an effective financing channel to secure funding in China. There are still some practical difficulties for foreign investors wanting to directly enter China's stock market. Although foreign-owned companies are permitted to enter Chinese stock markets, there are no examples of foreign company market listings to date. A more feasible and proven channel for foreign companies to enter the Chinese stock market is to purchase partial shareholdings of listed companies.

NOTES

1. *Foreign Investment Industry Guideline Directory*, approved by the State Council, effective from April 1, 2002.

CHAPTER 5

Trade Promotion Opportunities

Trade Shows and Exhibitions in China

CP technology and equipment trade shows and exhibitions are generally combined with environmental protection exhibitions in China. Renewable and clean energy, energy efficiency, and resource reclamation and utilization are the main focus of these shows. Some relevant trade shows and exhibitions hosted in China in 2003 and 2004 are described in the following sections.

Exhibitions in 2003

China (Nanjing) Environmental Protection Technology and Equipment and Water Supply, Wastewater Treatment Technology and Equipment Exhibition 2003
Date: December 23–26, 2003
Venue: Nanjing, China

China (Foshan) International Environmental Protection Technology and Product Exhibition 2003
Date: December 17–20, 2003
Venue: Foshan, Guangdong, China

The Eighth China International Environmental Protection Exhibition and Conference
Date: December 15–18, 2003
Venue: Beijing, China

The Fifth China (Guangzhou) International Environmental Protection Exhibition 2003
Date: November 19–22, 2003
Venue: Guangzhou, China

China (Tianjin) International Environmental Protection, New Energy, Solar Energy Technology and Equipment Exhibition 2003
Date: November 12–15, 2003
Venue: Tianjin, China

International Environmental Protection Technology and New Energy Exhibition 2003
Date: November 6–8, 2003
Venue: Guangzhou, China

Shanghai International Environmental Protection Technology and Equipment Exhibition 2003
Date: October 23–25, 2003
Venue: Shanghai, China

Energy Efficiency Technologies and Equipment in Modern Factories Exhibition
Date: September 26–28, 2003
Venue: Guangzhou, China

China (Zhengzhou) International Environmental Protection Technology and Equipment Exhibition 2003
Date: June 26–29, 2003
Venue: Zhengzhou, China

The Third Helongjiang International Environmental Protection Exhibition 2003
Date: April 24–26, 2003
Venue: Harbin, China

Exhibitions in 2004

2004 Xi'an International Exchange Stocking Fair for Pollution Control and Water Industry Technology Equipment
Date: March 10–13, 2004
Venue: Xi'an, China
Sponsors: Xi'an City Government, Shaanxi Economic and Trade Commission, Shaanxi Environmental Protection Bureau
Profile: Environmental protection technologies and equipment, including air pollution prevention and control technologies and equipment, desulfurization and denitrification technologies and equipment, automobile exhaust technologies, municipal solid waste utilization technologies and equipments, energy efficiency products and technical equipment, waste recycle utilization technologies and equipment, hazardous waste disposal technologies and equipment, CP technologies and equipment
Organizer: Shaanxi International Trade and Exhibition Company
Contact: Mr. Yang Dong
Tel: +86-29-2371888-8804, +86-29-2371898
Fax: +86-29-7801901

2004 China (Wuhan) International Environmental and Energy Efficiency Technologies Exhibition
Date: March 12–15, 2004
Venue: Wuhan, China
Sponsors: The Development Research Center of Hubei Provincial Government, China Council for the Promotion of International Trade (Wuhan Sub-Council), Hubei Association of Environmental Protection Industry
Profile: Water and wastewater treatment, domestic waste and industrial hazardous waste treatment, air pollution control, industrial waste gas treatment technology and equipment, automobile exhaust technology, clean coal technology, clean energy technology, environmental symbol products, green products, organic food and energy conservation products, environmental protection service, resource comprehensive utilization, CP technology and equipment
Organizer: Hubei Jiahe Culture Development Company
Contact: Ms. Lin Ping
Tel: +86-27-8725-3268, +86-27-8725-3134, +86-27-6240-6086, +86-13-9714-3432
Fax: +86-27-8725-3268

2004 Chongqing International Environmental Protection and Environmental Monitoring Technology and Equipment Exhibition
Date: March 18–20, 2004
Venue: Chongqing, China
Sponsors: Chongqing Environmental Protection Engineering Designing Institute, Chongqing Real Estate Board of Trade
Profile: Environmental monitoring and protection technology and equipment; solid waste treatment technology and equipment; resources comprehensive utilization; gas, liquid, and solid waste recycling technology and equipment; industrial waste gas removal technology and equipment; clean coal technology; CFC substitute production; clean energy technology
Organizer: Chongqing Saiwei Exhibition Service Co., Ltd.
Contact: Mr. Ye, Ms. Shu
Tel: +86-23-6291-9687, +86-23-6291-9837
Fax: +86-23-62919-907
E-mail: *yemufan2002@163.com*

2004 The Fifth China International Environmental Protection Technology and Equipment Exhibition
Date: April 7–9, 2004
Venue: Beijing, China
Sponsors: China Council for the Promotion of International Trade (Beijing Sub-Council), Environmental Engineering Committee of Chinese Society for Environmental Sciences
Profile: Air prevention and dust control technology and equipment; fly ash cleaning technology; desulfurization and denitrification technology; industrial waste gas removal equipment; resource comprehensive utilization; gas, liquid, and solid waste recycling technology and equipment
Organizer: Beijing International Exhibition Center
Contact: Mr. Wang Hongguo
Tel: +86-10-8586-6179-218, +86-10-8581-0652, +86-13641187719
Fax: +86-10-8586-6179-211
E-mail: *qifazhl@263.net*

2004 Asia International Rnewable Energy Technologies and Equipments Exhibition
Date: April 7–9, 2004
Venue: Beijing, China
Sponsors: China Academy of Engineering, China Technology Innovation Corporation, Science and Technology Department of Russia Federation, U.S. Renewable Energy Committee
Profile: Biomass energy, waste recycling, geothermal energy, heat recycling, wind/pv hybrid system, hydrogen energy, fuel cell, ocean energy (tidal energy and wave energy), waterpower, solar energy, pv generation, wind energy, renewable energy comprehensive service
Organizers: Shenyang Chengxin International Exhibition Co., Ltd., China International Science and Technology Exhibition Center
Contact: Ms. Li Jingwen
Tel: +86-10-6439-0338
Fax: +86-10-6439-0339
E-mail: *vivian@gracefair.com*

Environmental Protection and Energy Saving China (Fujian) 2004
Date: April 22–24, 2004
Venue: Fuzhou, China
Sponsors: The People's Government of Gujian, Fujian Environmental Protection Bureau, Fujian Construction Bureau, Fujian Water Supply Company, Fujian City Construction Association, Fujian Energy Saving Technology Service Center, Fujian Economic and Technology Development Service Center
Profile: Pollution control technology and equipment, used resource reclamation technology, environmental protection service, environmental monitoring and protection technology, ecology remediation and protection technology, energy efficiency and CP technology, solar energy, renewable energy technology and equipment
Organizers: Fujian Economic and Technology Development Service Center, China Council for the Promotion of International Trade (Fujian Division), Fuzhou Exhibition Center
Contact: Ms. Anhui
Tel: +86-591-3362411
Fax: +86-591-3362411

The Fifth China (Shanghai) International Environmental Protection Technology and Equipment Exhibition
Date: May 19–21, 2004
Venue: Shanghai, China
Sponsors: Shanghai Environmental Protection Industry Association, Shanghai Water Purifying Technology Institution, Shanghai FESCO International Exhibition Advertisement Co., Ltd.
Profile: Municipal and industrial wastewater treatment technology, air pollution control technology and equipment, desulfurization and denitrification technology and equipment, automatic waste gas treatment technology, domestic waste utilization technology and equipment, hazardous waste treatment technology and equipment, CP technology and equipment, environment symbol products
Organizer: Shanghai Zhongmao Exhibition Service Co., Ltd.
Contact: Ms. Li Nan
Tel: +86-21-5464-1713, +86-21-5464-1743
Fax: +86-21-6494-2305
E-mail: *zmes@zhongmao.com.cn*
Web: *www.eptee.com*

Ifat China 2004 International Trade Fair for Environmental Protection
Date: June 29–July 2, 2004
Venue: Shanghai, China
Sponsors: Messe München GmbH, Internationaler Messe-und Austellungsdienst GmbH (International Exhibition and Fair Service), Shanghai New International Expo Center Co., Ltd., China Association of Resources Comprehensive Utilization
Profile: Water treatment technology, resource reclamation technology, waste gas treatment, clean energy (wind energy, solar energy, waterpower, biomass energy, geothermal energy), energy efficiency products and technologies, new energy and renewable energy, environmental management and environmental audit
Frequency: Every two years
Organizer: Munich Trade Fairs Consultancy (Shanghai) Co., Ltd.
Contact: Li Shihao, An jun
Tel: +86-21-6876-6868
Fax: +86-21-6876-5909

E-mail: *info@mmi-shanghai.com*
Web: *www.ifat-china.com or www.mmi-shanghai.com*

China International Environmental Protection Energy Saving and Resources Comprehensive Utilization Exhibition
Date: September 21–24, 2004
Venue: Beijing, China
Sponsors: China Council for the Promotion of International Trade—Machinery Sub-Council, Machinery and Environmental Industry Development Center
Profile: Environmental protection technologies and equipment (wastewater, air, solid waste pollution control), energy efficiency and resource comprehensive utilization (energy efficiency technology and equipment, renewable energy, clean energy, clean fuel)
Frequency: Every two years
Organizer: China Council for the Promotion of International Trade—Machinery Sub-Council, Machinery and Environmental Industry Development Center
Contact: Ms. Kang Wei
Tel: +86-10-6859-4982
Fax: +86-10-6859-4996
E-mail: *laizhan-mach@ccpit.org*

Technical Seminars and National and Regional Working Groups Pursuing CP Practices, Regulations, and Standards

Technical Seminars in 2003 and 2004

Seminar on New Century Commodity Trade Environment
Date: August 24–28, 2004
Venue: Beijing, China
Profile: New trends in modern materials and technology, technology management and innovation management, quality management (quality systems, quality tools, quality testing, and quality certification), quality of commodities (technical and other products and food products), marketing, e-commerce and logistic management, WTO and globalization, ecological design, CP, cleaner products and cleaner service, sustainable development and environmental management, waste management
Organizer: China Society of Commodity Science
Contact: Dr. Li Jianghua
Tel: +86-10-6251-2851
Fax: +86-10-6251-5305
E-mail: *jianghua@cscs.org.cn*
Web: *www.cscs.org.cn*

China Commercial Fly Ash and Slag Milling Processing and Application Technologies Communication Conference
Date: November 28–30, 2003
Venue: Shanghai, China
Profile: Current situation and trends of commercial fly ash application in foreign countries; domestic and overseas technical situation and trends of slag milling production, processing, and application; analysis of and research on high efficiency comprehensive application of fly ash; current application situation of fly ash in commercial cement industry; research on high-value application of fly ash
Contact: Wang Wenli, Wu Xiaoyuan
Tel: +86-10-6574-8832, +86-10-5116-4634, +86-135-0139-0850
Fax: +86-10-6574-8832
E-mail: *nonmetal@chinanmm.com, wxh@chinanmm.com*

Chemical Industry Academic Association Annual Meeting on Environment Protection 2004
Date: May 2004
Venue: Beijing, China
Focus: Promoting P2 and pollution control and achieving sustainable development in the chemical industry
Organizers: Committee on Environment Protection of the Chemical Industry and Engineering Society of China, Department of Safety and Environment of China Petroleum and Chemical Corporation, Chemical Pollution Prevention and Control Society of China
Contact: Mr. Qi Hongwei, Mr. Chen Dianying
Tel: +86-10-6428-7757, +86-10-6421-1381
E-mail: *cccpcp@public.bta.net.cn, hghb@brici.ac.cn*

Setting the Agenda for China's Environmental Reform: Past, Present, and Future Trends
Date: June 5–6, 2004
Venue: Beijing, China
Sponsors: Environmental Policy Group, Wageningen University, The Netherlands
Profile: This conference invites paper contributions that focus on environmental dimensions of rapid industrialization and urbanization in Asian transitional economies. Appropriate topics include, but are not limited to, theoretical, methodological, and policy perspectives on national environmental policy and new institutional arrangements, globalization and environment, rural-industrial environmental issues, natural resource management, foreign investments, international trade and environmental policy (WTO, ASEAN, APEC), environmentalism, green non-governmental organizations and public disclosure, green consumption and production, water pollution control and urban environmental issues, waste management, and renewable energy
Organizer: Tsinghua University
Contact: Mr. Du Pengfei
Tel: +86-10-6277-1468 ext. 11
Fax: +86-10-6278-5687
E-mail: *enrich2004@sina.com*

National and Regional Working Groups Pursuing CP Practices, Regulations, and Standards

In China, the Environmental and Resources Protection Committee of the National People's Congress is the legislature of CP-related laws. NDRC and SEPA are the major administrations authorized to draft CP-related regulations and simultaneously manage and direct the implementation of CP in China. CP centers at different levels are generally authorized to draft CP standards and technical requirements, organize CP training and audits, provide CP technical service, and engage in other CP-related activities. The working scopes of these institutes or organizations are detailed in the following sections.

Environmental and Resources Protection Committee of the National People's Congress

The Environmental and Resources Protection Committee is mainly responsible for establishing and improving environmental and resource protection laws in China. The committee's legislative mission for the next five years is to prepare the Renewable Energy Promotion Law and to revise the Solid Waste Prevention and Control Law. Activities related to CP laws are as follows:

- **Developing implementation details of the CPPL**: Detailed rules are being prepared to make this law more practical, focusing on a set of policies for capacity building, scientific research, tax reform, and investment and financing.
- **Drafting the Recycle Economy Promotion Law**: The committee has performed legislation surveys for drafting this law. Several demonstration projects for the recycling sector have been organized by SEPA in different regions of China.

Administrative Authorities

The two administrative authorities and their functions are described below:

- **National Development and Reform Commission**: Two departments under NDRC control are responsible for issues related to CP: the Department of Resource Conservation and Comprehensive Utilization and the State Energy Administration (National Oil Storage Office). The first department is responsible for issuing policies and drafting plans for resource conservation and comprehensive utilization. It also has the authority to coordinate and organize CP activities in China, such as establishing demonstration projects and promoting new products, technology, and equipments. The second department is responsible for drafting energy development plans and policies for energy efficiency and developing new and renewable energy resources.
- **State Environmental Protection Administration**: With respect to CP and pollution prevention, SEPA focuses on the following five responsibilities:

  1. Organize fundamental research on cleaner production

2. Promote the implementation of CP in severely polluted regions
3. Establish a CP information sharing system
4. Establish CP demonstration bases
5. Strengthen CP training and information sharing

CP Centers

China's CP centers are described below:

- **China National Cleaner Production Center**: The China National Cleaner Production Center was established in December 1994 by SEPA. The China National Cleaner Production Center has conducted a series of CP activities to promote environmental strategies in China, including pollution control and prevention. Its primary area of responsibility includes organizing research on CP theories and methods (including eco-industry park and recycle economy), conducting training and audits, and evaluating and promoting CP technology.
- **Center for Environmentally Sound Technology Transfer**: The Center for Environmentally Sound Technology Transfer was founded in 1998 with support from the Ministry of Science and Technology and the ADB. Its headquarters are in Beijing, with two regional centers in Chengdu and Tianjin. The center is also a non-profit organization, as an affiliated member of the Administrative Center for China's Agenda 21; it is responsible for China's Agenda 21 priority program for international cooperation. The aim of the Center for Environmentally Sound Technology Transfer is to promote cooperation between Chinese enterprises (especially medium and small enterprises) with government research institutes, financial institutions, international organizations, and foreign companies. It has been working on providing technical assistance to small and medium-sized companies on environmentally friendly technologies, providing technical assessment and feasibility studies, and establishing information systems on technology transfer.
- **Industrial CP Centers**: By the end of 2001, several industrial CP centers in the petro-chemical, chemical, metallurgy, aeronautics, shipping, textile, and light industries had been established. Generally, the major responsibilities of these industrial centers are to guide CP in corresponding industries, provide new technologies for comprehensive utilization, compile and conduct training programs, and support international cooperation projects on CP.
- **Local CP Centers**: By the end of 2001, 22 local CP centers were established as members of the national CP network. The provincial CP centers are in Beijing, Tianjin, Inner Mongolia, Shanxi, Xinjiang, Gansu, Shandong, Liaoning, Heilongjiang, Hunan, Jiangsu, Shanghai, Jiangxi, Yunan, and Qinghai Cleaner Production Centers. City-level CP centers have also been established in Hohehot, Taiyuan, Shenyang, Benxi, and Changsha. These local CP centers are generally responsible for the promotion and implementation of CP in local areas.

Regional Opportunities in China

National Western Development

The Great Western Region covers Xinjiang, Inner Mongolia, Tibet, Qinghai, Ningxia, Gansu, Shaanxi, Sichuang, Yunnan, Guizhou, and Guangxi provinces and the municipality of Chongqing. The economic status in this region is generally undeveloped, and the central government has implemented the National Western Development Strategy, which offers preferential policies to promote economic and social development in this area.

Consistent with the *Foreign Investment Industry Guideline Directory*,[1] foreign investment in the Great Western Region can access equipment imports free of tariffs and value-added taxes. In addition, restrictions on the shareholding proportion by foreigners and investment industries in the region are less stringent than in eastern and coastal areas. For instance, new industries such as the new-type drying cement production line with a daily

Table 5.1
Coverage Areas of Acid Rain and SO_2 Control Zones

Coverage Areas	
Acid Rain Control Zone	
Province	Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Sichuan, Guizhou, Yunnan
Autonomous region	Guangxi Zhuang
Municipality	Shanghai, Chongquig
SO_2 Control Zone	
Province	Hebei, Liaoning, Jilin, Jiangsu, Shandong, Henan, Shanxi, Gansu, Shaanxi
Autonomous region	Inner Mongolia, Ningxia Hui, Xinjiang Uighur
Municipality	Beijing, Tianjin

capacity of greater than 2,000 tons are encouraged only in China's middle and western regions.

With the support of these preferential policies, the relatively low industrialization level in the Great Western Region will undoubtedly create market space for foreign investors, and advanced technology and equipment are needed in this region.

Industry Reconstruction in the Three Provinces of Northeastern China

In August 2003, the central government formally initiated the reconstruction of the three provinces in Northeast China: Liaoning, Jilin, and Heilongjiang. These provinces were the traditional large industrial manufacturing zones in China that made the greatest contribution to China's industrialization and development in the 1950s and 1960s. In recent years, improper industry structures and aging technology and equipment have greatly hampered development in these once-dominant provinces. Under such circumstances, it is believed that industry reconstruction in these provinces will bring new prosperity to these provinces that were once the traditional industrial bases of the country.

The NDRC has publicized the first 100 projects for the reconstruction plan. The total investment of these projects is US$7.4 billion, with major financing coming from commercial bank loans and capital invested by companies. State bonds with discount interest rates are available for most projects.

There are 52 projects located in Liaoning Province, with a total investment of US$5.3 billion, including—

- 21 projects in equipment manufacturing (US$624 million)
- 26 projects in the raw materials industry (US$4.6 billion)
- 5 projects in the processing of farm product

Detailed information about the projects in Jilin and Heilongjiang provinces is currently not available.

Regional Acid Rain and SO_2 Control Program

China has recognized its acid rain and SO_2 pollution problems, and SEPA has identified acid rain and SO_2 control zones. The coverage areas/zones are presented in Table 5.1.

The area of acid rain and SO_2 control zones covers 27 provinces, autonomous regions, or

Table 5.2
Coverage Area of the Three Active Economic Deltas

Region	Coverage Area
Jing-Jin-Tang Economic Delta	Beijing, Tianjin, Tangshan, Qinhuangdao, and Tanggu in Hebei Province
Shanghai-Yangtze Economic Delta	Shanghai, and Jiangsu and Zhejiang Provinces
Pearl River Economic Delta	Shenzhen, Guangzhou, Dongguan, Foshan, Jiangmen, Zhongshan, Huizhou, and Gaozhou cities

municipalities encompassing an area of 1.09 million km^2 or 11.4 percent of China's total land area. It covers 4 municipalities, 21 provincial capitals, 11 open cities in coastal areas, and 4 special economic zones (Shenzhen, Zhuhai, Shantou, and Xiamen cities). The population in these areas account for 39 percent of China's total population, and the GDP in these areas account for nearly 70 percent of China's GDP. It is evident that those areas/cities in the acid rain and SO_2 control zones have contributed significantly to China's economic development; however, this has often been at the price of creating severe pollution problems.

The pollution control measures for companies located in the acid rain and SO_2 control zones are described as follows:

- Newly built or reconstructed coal mining facilities with sulfur content higher than 1.5 percent must install coal washing and selection facilities. Existing coal mining must construct coal washing and selection facilities as planned.
- Newly built or reconstructed power plants using coal with a sulfur content higher than 1 percent must install desulfurization equipment. Existing power plants using coal with a sulfur content higher than 1 percent are required to install desulfuration devices before 2010.
- Chemical, metallurgy, construction materials, nonferrous metals industries, and other industries generating heavy pollution are required to construct waste gas treatment facilities and employ other discharge reduction techniques.
- CP, technical renovation, resource conservation, and resource comprehensive utilization will be promoted and strengthened.

These policies have created strong market opportunities for desulfurization devices and CP technologies and equipment in these relatively affluent acid rain and SO_2 control zones.

Economic Delta (Jing-Jin-Tang Economic Delta, Shanghai-Yangtze River Economic Delta, and Pearl River Economic Delta)

After more than 20 years of development, three extraordinarily active economic deltas have come into being: the Jing-Jin-Tang Economic Delta, Shanghai-Yangtze River Economic Delta, and Pearl River Economic Delta. The areas of these regions are presented in Table 5.2.

Official data can demonstrate the economic position of these three deltas in China:

- In 2002, Beijing realized a GDP of US$37.8 billion. The per capita GDP is US$3,355.
- At present, the GDP of the Shanghai-Yangtze Economic Delta has reached approximately 20 percent of the total national GDP.
- In 2001, the Pearl River basin GDP was US$110.7 billion, accounting for almost 90 percent of Guangdong Provinces' total GDP and 9.5 percent of the national GDP.

It is obvious that these three economic deltas have made great economic contributions to China's growth. On one hand, economic prosperity has brought financial affluence to the region, but on the other hand, it has caused severe pollution in these

regions with heavily polluted Tai Lake, Hai River, and the Pearl River as evidence of this negative impact. Conversely, the economic power of these regions means they can afford to implement relatively stricter pollution prevention measures. Jiangsu Province is a good example with its active practice in pollution control and CP. Consistent with their economic importance, CP market opportunities are believed to be plentiful, and there is increasing demand for pollution prevention measures and equipment.

Jiangsu Province initiated the experimental implementation of Enterprises' Environmental Information Publication System in the city of Zhenjiang in 2000 with support from the World Bank. This system was implemented and promoted throughout the entire province the following year. This system draws the publics' attention to companies' pollution control practices and creates public pressure to motivate companies to improve their environmental practices. In addition to this system, CP audits are used as a tool to facilitate the development of CP. It is reported that the Jiangsu Provincial EPB has been conducting company CP audits for three years and completed 100 audits in 2002.

On the basis of the example set by Jiangsu Province, it is estimated that strong economic power and stricter regulatory requirements in more developed regions, such as these three economic deltas, will create an attractive market for CP technology and equipment.

Tai Lake Watershed CP Program

Tai Lake is the third largest freshwater lake (about 2,400 km^2) in China, located in the southern part of Jiangsu Province, just west of Shanghai. The surrounding area is a densely populated fertile delta plain with many small lakes, ponds, streams, and human-made canals, including the Grand Canal. Tai Lake is also a major water source for this rather industrialized region, and pollution from industrial waste, sewage, and agricultural runoff is significant. There is contamination from heavy metals, and the lake is highly eutrophic (rich in nutrients that promote plant life) with frequent blue-green algae blooms. These blooms reduce the dissolved oxygen content and its suitability to sustain fish and other organisms.

The textile, printing, and dye industries are major sources of pollution in Tai Lake. The problem is magnified by the relatively low technology employed by these companies. Also contributing is the fact that the energy and resource consumption of the textile companies is one to two times that in developed countries. The textile industry is not alone in these inefficiencies and is typical of that of the other industries in the area.

To effectively counter the pollution levels in the Tai Lake watershed, the Chinese government has developed this region into a CP demonstration base. Detailed requirements for achieving this aim include the following:

- All companies in the Tai Lake watershed are required to conduct a CP audit before 2005.
- Various CP measures should be taken in textile, printing, and dyeing companies, including implementing advanced technology, upgrading existing processes, using environmentally friendly raw material substitutes, and improving product reclamation and utilization methods.

By the end of 2002, 153 priority companies in the Tai Lake watershed had conducted CP audits; however, to realize the government's 2005 target, many additional CP audits and technical upgrades and innovations are required in this region.

NOTES

1. *Foreign Investment Industry Guideline Directory*, approved by the State Council, effective from April 1, 2002.

CHAPTER 6

Case Studies on Successful Projects with Foreign Participation

The first international organization or foreign government involvement in CP in China was in 1993 when the World Bank cooperated with China in the establishment of a CP methodology system and the preparation of CP audit manuals. Since then, many organizations and governments—including the World Bank, ADB, United Nations Development Programme, United Nations Industrial Development Organization, the European Union, the United States, Canada, Australia, the United Kingdom, Germany, Sweden, Holland, Norway, and Japan—have participated in almost 20 CP cooperative projects in China. These projects focus on CP training and audits, CP methodology and manual preparation, demonstration industry and company establishment, and demonstration technology development. Most of these projects are funded by grants from international organizations or foreign governments, and technical aid is the primary method of assistance. The involvement of foreign organizations and governments has greatly contributed to CP advancement in China. Two successful examples are described in the following sections.

United States–China CP Project in Petrochemical, Metal Finishing, and Pharmaceutical Industries

From 1995 to 1997, funded by the Japanese Grant Facility and grants by the World Bank, the China National Cleaner Production Center cooperated with the Illinois Environmental Protection Agency to identify and promote CP in China. This project conducted CP audits at six representative companies in the petrochemical, metal finishing, and pharmaceutical industries, to identify demand for CP/P2 technology, and select U.S. demonstration technologies to be employed in these companies. The aim was to investigate the CP technology market in these industries and to seek opportunities to introduce U.S. CP technology in China.

This cooperative project mainly included training in CP technology and P2 audit methodology; CP auditing in demonstration companies; and expert assessment, review of typical CP technologies, and screening of demonstration companies, suitability to adopt these technologies.

The major achievements were as follows:

- Various CP training courses were delivered to more than 700 trainees.
- Through CP audits, the six demonstration companies generated 128 CP options. Fifty-seven options were implemented with an overall investment of US$0.65 million, bringing about an overall economic benefit of US$1.2 million as well as obvious environmental benefits. For example, wastewater from these companies was reduced by 144,479 tons/year, COD was reduced by 452.09 tons/year, and SO_2 was reduced by 461 tons/year.
- Forty-four typical CP technologies were implemented, including 15 in the petrochemical (refinery) industry, 15 in the pharmaceutical industry, and 14 in the metal finishing industry. CP/P2 guidance of U.S. petrochemical (refinery), metal finishing, and

pharmaceutical industries were translated into Chinese and distributed throughout the three industries. Sectoral CP incentive mechanisms were researched, and recommendations were developed to further promote CP in China.

Canada–China Cooperative CP Project in the Chemical Industry

The location of this Canada–China cooperative CP project was in the Fuyang Chemical General Works, Fuyang City, Anhui Province. The project was initiated in 1996 and funded by CIDA.

The major products at the Fuyang Chemical General Works included ammonium bicarbonate and urea fertilizers. The production capability was 200,000 tons/year with a gross value of US$30 million. As is typical of fertilizer plants, the facility generated large amounts of air and water pollution, especially ammonia and sulfur.

During the period of the Canada–China cooperative CP project, Canadian engineers and process specialists worked closely with Fuyang plant personnel to identify practical, zero-, low-, and medium-cost ways to improve productivity and profitability while reducing pollutant discharges. The main directives of the project were as follows:

- Minimize water consumption
- Use raw materials and energy more efficiently
- Recover, reuse, or recycle losses of raw materials or finished products
- Handle raw materials, intermediate products, and finished goods carefully and safely

Based on these principles, the following actions were conducted:

- A CP audit, with the preparation of process flow diagrams was conducted as a basic step.
- Twenty-eight process flow diagrams were developed at the Fuyang plant. Each described a specific unit process, including all major process equipment (pressure vessels, reactors, scrubbers, coolers, and pumps), and streams
- Environmental emissions (liquid effluents, air emissions, and wastes) from every item of process equipment were systematically assessed.
- A list of all environmental emissions was prepared, indicating the sources (that is, equipment number), the nature (stream number), the point of discharge, and the general composition and frequency (for example, continuous emission, intermittent emission, blow downs, and periodic maintenance).
- CP measures were identified to reduce ammonia; some measures also were identified in other areas of operations.
- Ten zero- and low-cost ammonia reduction solutions and three medium-cost measures were implemented. The total investment for medium-cost measures was US$0.2 million.

The benefits that resulted from the implementation of identified CP measures were considerable. For instance, in the first full year of implementing zero- and low-cost CP measures, production in the Fuyang plant increased by 3 percent, with savings of US$1.8 million. Reduced raw material consumption and pollution discharges also were achieved. By implementing medium-cost measures, water consumption was reduced by 37,400 tons/year and the amount of money saved was US$0.44 million/year, which ensured an investment recovery period of less than one year. In general, the project was a success and proved that both economic and environmental benefits could be achieved through implementation of CP measures.

APPENDIX A

Key Projects Seeking Foreign Investment and Cooperation

The energy efficiency and pollution prevention projects with potential for investment and cooperation are described in this appendix. It must be clarified that the financial forecasts for the projects were obtained from the identified contacts. Potential investors are strongly advised to undertake their own financial due diligence and analyses to assess the market viability of the financial forecasts presented by these industries.

Cement Industry

No. 1: Reconstruction of Aluminum Fluoride Project
Location: Wuwei City, Gansu Province
Status: Project proposal approved and feasibility study report completed
Total investment: Information not available
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: The key technique will be imported from Germany, and the planned capacity will be 30,000 tons per year.
Comment: The return term for the whole project is projected to be about eight years, with a total potential annual income of 21,000,000.
Contact: JinChang Cement Co. Ltd.
Person in charge: Du Rutie
Tel: +86-935-7324470
Fax: +86-935-7324794
Postal code: 737109

No. 2: Fly-Ash Bricks Production Line Project
Location: Huhehaote City, Inner Mongolia, Autonomous Region
Status: Project proposal approved and feasibility study report completed; investment a major problem.
Total investment: US$30,900,000
Funding source: Loan from commercial bank (116,050,000 RMB yuan), foreign investment (92,910,000 RMB yuan), Enterprise (44,650,000 RMB yuan)
Cooperation form: Cooperation or joint venture
Brief description: The capacity will be 500,000,000 bricks per year. The purpose of this project is waste reuse.
Comment: The total annual sales income is estimated at US$13,900,000, including a potential profit worth US$4,700,000 before taxes.
Contact: Economy and Trade Committee of Huhehaote City
Person in charge: Yin Chengzhong
Address: Room 1110, Office Building of Huhehaote Government
Tel: +86-471-4606297

No. 3: High Fly-Ash Proportion with Argil Facing Brick Production Line
Location: Huhehaote City, Inner Mongolia, Autonomous Region
Status: Proposal under preparation
Total investment: US$10,000,000
Funding source: Foreign investment (US$84,000,000)
Cooperation form: Cooperation, joint venture, or sole investment
Brief description: The annual capacity will reach 300,000,000 bricks. This project will have good effects on energy saving and infield protection.

Comment: The total annual income as projected is US$8,300,000, including a potential profit worth US$3,400,000 before taxes.
Contact: Huhehaote City Economy and Trade Committee
Person in charge: Yin Chengzhong
Address: Room 1110, Office Building of Huhehaote Government
Tel: +86-471-4606297

No. 4: Drying Process Cement Production Project
Location: Dayu County, Gansu Province
Status: Feasibility study report finished
Total investment: US$2,300,000
Funding source: Information not available
Cooperation form: Sole investment, cooperation, or joint venture
Brief description: The daily capacity will be 2000 tons, and this project is located in an industrial park.
Comment: The total annual income is estimated at US$21,800,000
Contact: Planning Committee of Dayu County

No. 5: Reuse Project of Industrial Waste Residue
Location: Huahuan County, Hunan Province
Status: Feasibility study report is under preparation
Total investment: US$3,500,000
Funding source: Foreign investment (US$1,200,000)
Cooperation form: Cooperation, joint venture, or other
Brief description: According to the primary design, the project will use waste residue to produce cement, which will reach a daily capacity of 400 tons.
Comment: The total estimated annual sales income is US$5,500,000, which includes US$2,500,000 as the potential profit before taxes.
Contact: Jingang Construction Co. Ltd.
Persons in charge: Zhang Jingming and Long Bingwu
Tel: +86-743-7221158, 7221948
Mobile: 13508436699
Postal code: 416400

No. 6: Drying Process Cement Production Project
Location: Zoucheng City, Shandong Province
Status: Feasibility study report under preparation
Total investment: US$7,300,000
Funding source: Foreign investment (US$4,400,000)
Cooperation form: Cooperation or joint venture
Brief description: According to the primary design, the project will use an advanced dry process to produce cement, which will reach a daily capacity of 2,500 tons.
Comment: The projected return term is four years, with a total potential annual income of US$30,000,000 with an internal return rate of 25 percent.
Contact: Yongqiang Cement Production Co. Ltd. of Zoucheng City
Persons in charge: Chen Ertai and Xu Guoming
Tel: +86-537-2316184
Fax: +86-537-2314528
E-mail: invest@sd163.net

No. 7: High-Quality Cement Project
Location: Rangfen County, Shanxi Province
Status: Feasibility study report under preparation
Total investment: US$18,100,000
Funding source: Foreign investment (US$121,000,000), enterprise (US$6,000,000)
Cooperation form: Joint venture or cooperation
Brief description: According to the primary design, the project will use an advanced process, which will use wastewater and waste residue as resources to produce cement, with an annual capacity of 600,000 tons.
Comment: The construction period will be one year, and the total income is expected to rise to US$13,000,000 one year after operation.
Contact: Nonferrous Metal Industry Co. Ltd. of Rangfen County, Shanxi Province
Person in charge: Wang Jianguo

No. 8: Plaster (from desulfuration) and Fly-ash Comprehensive Utilization Project
Location: Jiangjin City, Sichuan Province
Status: Feasibility study report under preparation
Total investment: US$6,650,000
Funding source: Information not available

Cooperation form: Sole investment, cooperation, or joint venture
Brief description: This project will annually produce 1,000,000 square meters of hollow plaster bricks, and reuse 400,000 tons of flying-ash. All the plaster and flying-ash will be supplied by a power plant nearby.
Comment: The construction period will be one year, and it is estimated that the return term will be six to seven years. The sales income is estimated to be US$9,700,000, with an internal return rate of 16 percent.
Contact: Business Office of Jiangjin Government
Person in charge: He Wenwu
Tel: +86-23-4753-0540
Fax: +86-23-4754-9490
Postal code: 402260

No. 9: High-Quality Cement Project
Location: Chongqing City
Status: Investment being applied for
Total investment: US$14,220,000
Funding source: Information not available
Cooperation form: Sole investment, joint venture, or cooperation
Brief description: According to the primary design, the project will use an advanced process, which will use wastewater and waste residue as resources to produce cement, with a daily capacity of 1,000 tons.
Comment: The construction period will be one year and the total income is projected to be US$13,000,000 one year after operation.
Contact: Jiangxin Construction Co. Ltd. of Chongqing City
Persons in charge: Lei Huasi, Huang Guangli, and Liu Xiaolin
Tel: +86-23-6623-0252
Fax: +86-23-6623-0226

Power and Energy Industry

No. 1: Metallurgical Coke Project
Location: Anze County, Shanxi Province
Status: Feasibility study report under preparation
Total investment: US$47,000,000, with US$5,900,000 for Phase I
Funding source: For Phase I: foreign investment (US$1,900,000), enterprise (US$4,000,000)
Cooperation form: Joint venture
Brief description: The project is to produce metallurgical coke of high quality, and the capacity will be 600,000 tons per year. The whole project comprises three phases.
Comment: Phase I could have an annual sales income of US$11,000,000, and an annual profit of US$900,000 before taxes.
Contact: Yongxin Coke Production Co. Ltd. of Anze County
Person in charge: Liang Yongzi

No. 2: Coking Coal Project
Location: Linfen City, Shanxi Province
Status: Information not available
Total investment: US$30,000,000
Funding source: Foreign investment (US$24,000,000)
Cooperation form: Cooperation or joint venture
Brief description: The capacity will be annually 300,000 tons, and this project will also produce some related chemical products. The key equipment is imported from Germany.
Comment: The construction period will be 18 months, and the return term has been estimated to be four to five years. The annual sales income is estimated at US$29,700,000, which contains an annual potential profit of US$7,400,000 million before taxes.
Contact: Jinyu Industry Co. Ltd., Linfen City
Persons in charge: Wang Qinghuan and Yang Tianwen
Address: Raodu District, Linfen City, Shanxi Province

No. 3: Expansion Project of Labudalin Power Plant
Location: Eerna City, Inner Mongolia Autonomous Region
Status: Information not available
Total investment: US$5,900,000
Funding source: Information not available
Cooperation form: Stock sharing or loan
Brief description: This is Phase 2 of a co-generation project with a total service area of 400,000 square meters. The air quality will be improved because of this project.

Comment: The return term is projected to be eight years with an internal return rate of 15 percent.
Contact: Business Bureau of Erena City, Nei Mongol.
Person in charge: Li Huishi
Tel: +86-470-6829199

No. 4: Coal Bed Methane Utilization Project
Location: Lanzhou City, Gansu Province
Status: Feasible study finished
Total investment: Information not available
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: This environmental protection project involves a 400 square meter coal bed. Methane will be used for heat supply.
Comment: This project could have an annual sales income of US$1,000,000, and an annual profit of US$600,000 before taxes.
Contact: Jingyuan Coal Industry Co. Ltd.
Person in charge: Cao Yingwu
Tel: +86-931-6657921
Postal code: 730000

No. 5: Coal Gangue Power Generation Plant
Location: Datong City, Shanxi Province
Status: Investment being applied for
Total investment: US$72,600,000
Funding source: Information not available
Cooperation form: Cooperation
Brief description: The total amount of waste coal gangue, which is of high quality, is about 4.2 million tons per year. It will be used to generate electricity in this project.
Contact: Datong Mingding Industry Co. Ltd.
Person in charge: Manager Liu
Tel: +86-352-7050970
Email: bgcui@eyou.com
Postal code: 037003

No. 6: Co-generation Project
Location: Hongdong County, Shanxi Province
Status: Feasibility study report finished
Total investment: US$72,600,000
Funding source: Information not available
Cooperation form: Cooperation and joint venture
Brief description: The capacity will be 2 × 50 megawatts.
Comment: The return term is estimated to be six years, and the annual potential sales income could reach US$18,000,000, which includes a profit of US$11,200,000 before taxes.
Contact: Local Electricity Industry Company, Shanxi Province
Person in charge: Zhang Hualong
Tel: +86-351-4012459, 4012145
Fax: +86-351-4065050
Postal code: 030001

No. 7: Coal Bed Gas Exploitation
Location: Dacheng County, Hebei Province
Status: Proposal approved
Total investment: US$3,600,000 *Funding source*: Foreign investment (US$2,400,000), enterprise (US$1,200,000)
Cooperation form: Joint venture
Brief description: The capacity of this project will be 200 million cubic meters.
Comment: The annual sales income is projected at US$18,000,000, which contains a potential profit before tax of US$6,000,000. The return term is estimated to be five years.
Contact: Panning Bureau of Dacheng County
Person in charge: Li Jichen
Tel: +86-316-5522832
Postal code: 065900

No. 8: A Coal Gangue Co-generation Project
Location: Xintai City, Shandong Province
Status: Feasibility study report under preparation
Total investment: US$27,400,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: It is a waste reuse project, and the capacity will be 264,000 megawatt-hours per year.
Comment: The annual sales income is estimated to be US$188,600,000, and a potential profit of US$10,700,000 before taxes.
Contact: Xintai Mingtian Power Plant
Tel: +86-538-7222267

No. 9: Power Plant Project
Location: Hancheng City, Shaanxi Province
Status: Partly finished
Total investment: US$2,400,000
Funding source: Information not available

Cooperation form: Joint venture, cooperation, or compensation trade
Brief description: The construction scale of this power plant will be 2 × 12 megawatts, and coal gangue, the waste of mining, will be used as fuel.
Comment: The project could have an annual sales income of US$10,900,000, and an annual profit of US$900,000 before taxes.
Contact: Mining Bureau of Hancheng City
Persons in charge: He Tongmin and Zhang Xiaotong
Tel: +86-913-5212012–61153, +86-29-7427704
Fax: +86-913-5210679, +86-29-7443603
Postal code: 715400

No. 10: Co-generation Project
Location: Jianghu County, Jiangsu Province
Status: Feasibility study report under preparation
Total investment: US$400,000
Funding source: Information not available
Cooperation form: Cooperation, joint venture, or build-operate-transfer (BOT)
Brief description: This project will control the air pollution caused by scattered pollution sources, and dry precipitation will be used to reduce dust discharge.
Comment: The return term is projected at eight years, with a potential annual sales income of US$15,100,000, and an annual profit of US$1,500,000 before taxes.
Contact: Economy and Trade Committee of Jianghu County
Persons in charge: Jin Gen and Wang Shixian
Tel: +86-515-6232075
Fax: +86-515-6212117

No. 11: Co-generation Project
Location: Luohe City, Henan Province
Status: Approved
Total investment: US$24,200,000
Funding source: Foreign investment (US$18,100,000)
Cooperation form: Cooperation or joint venture.
Brief description: This is a co-generation project with a construction scale of 2 × 25 megawatts.
Comment: The return term is estimated to be five years, with a potential annual profit of US$8,500,000 million before taxes.
Contact: New and High-Tech Development Park of Luohe City
Persons in charge: Wang Weichao and Zhang Shuling
Tel: +86-395-2660566

No. 12: Wood Coal Wax Production and Waste Reuse Project
Location: Wudan Town, Nei Mongol Autonomous Region
Status: Feasibility study report under preparation
Total investment: US$9,500,000
Funding source: Foreign investment (US$2,900,000), loan from commercial bank (US$6,700,000)
Cooperation form: Cooperation, joint venture, or sole investment
Brief description: The capacity of wood coal wax will be 3,000 tons per year, and the waste will be used to generate electricity or produce cement.
Comment: The project has a potential annual sales income of US$8,300,000, and the related profit is annually US$2,900,000 before taxes.
Contact: Chifengwudan Chemical Co. Ltd.
Person in charge: Ming Xudong
Tel: +86-476-6331030
Fax: +86-476-6325682

No. 13: Co-generation Project
Location: Dongdu Town, Xintai City, Shandong Province
Status: Information not available
Total investment: US$6,000,000
Funding source: Information not available
Cooperation form: Cooperation
Brief description: The construction scale will be 12 megawatts, and coal gangue will be used as fuel.
Comment: The project could have an annual sales income of US$9,000,000, and an annual profit of US$3,100,000 before taxes, with an investment return rate of 52 percent.
Contact: Dongdu Chlorine Alkali Plant of Xintai City
Person in charge: Li Xuewen
Tel: +86-538-7372018
Fax: +86-538-7372018
E-mail: *lxw@sddongli.com*

No. 14: Integrated Utilization of Coal, Gas, and Electricity
Location: Jianxiang County, Shandong Province
Status: Approved
Total investment: US$3,400,000
Funding source: Information not available
Cooperation form: Cooperation
Brief description: This project consists of four phases. This is Phase I. The construction scale will be 230 kilowatts.
Comment: The cooperation period will be 15 years. The construction period will be 3 years, and the return term is estimated at 13 years, with a potential investment return rate of 8 percent.
Contact: Shandong Liyan Group
Persons in charge: Chen Ertai and Xu Guoming
Tel: 86-537-2316184
Fax: 86-537-2314528
E-mail: *invest@sd163.net*

No. 15: Co-generation Project
Location: Qufu City, Shandong Province
Status: Feasibility study report under preparation
Total investment: US$5,300,000
Funding source: Foreign investment (US$1,200,000)
Cooperation form: Cooperation.
Brief description: The construction scale will be 48 megawatts.
Comment: The construction period will be two years, and the return term is estimated to be five years, with an investment return rate of 20 percent.
Contact: Qufu Thermoelectricity Biological Co. Ltd.
Persons in charge: Chen Ertai and Xu Guoming
Tel: +86-537-2316184
Fax: +86-537-2314528
E-mail: *invest@sd163.net*

No. 16: Integrated Coal, Electricity, and Chemical Project
Location: Heze City, Shandong Province
Status: Feasibility study report under preparation
Total investment: US$1,349,000,000
Funding source: Information not available
Cooperation form: Cooperation, joint venture or sole investment.
Brief description: This project is located in a virgin coalmine, and this integrated project will contribute greatly to waste reduction and environmental protection.
Comment: The return term is projected to be 11 years, with a potential internal return rate of 12.69 percent
Contact: Business Bureau of Heze City
Person in charge: Sun Qing
Tel: +86-530-6166168

No. 17: Power Plant Project
Location: Rangfen County, Shanxi Province
Status: Feasibility study report under preparation
Total investment: US$56,200,000
Funding source: Foreign investment (US$45,900,000)
Cooperation form: Cooperation or joint venture
Brief description: The construction scale of this power plant will be 2 × 50 megawatts, and coal gangue will be used as fuel.
Comment: The construction period will be one and one-half years, and the annual profit is estimated to be US$6,000,000 before taxes.
Contact: Nonferrous Metal Industry Co. Ltd. of Rangfen County, Shanxi Province
Person in charge: Wang Jianguo

Chemical Industry

No. 1: Polyethylene Insulated Cable Project
Location: Huhehaote City, Inner Mongolia Autonomous Region
Status: Feasibility study report under preparation
Total investment: US$7,700,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: The plant will annually produce 3,000 kilometers of cable and nearly 3,000 tons of alloyed lines.
Comment: The annual sales income is estimated to be US$121,000,000, and the profit before taxes a potential US$12,100,000.
Contact: Responsible Organization: Inner Mongolia Cable Plant Huhehaote Economy and Trade Committee
Person in charge: Wang Huaishan

Address: Room 1110, Office Building of Huhehaote Government
Tel: +86-471-4606297

No. 2: Acid Humus Fertilizer Project
Location: Hulunbeier City, Inner Mongolia Autonomous Region
Status: Feasibility study report under preparation
Total investment: US$4,100,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: This project will use wood coal and biological fertilizer to produce acid humus fertilizer, which is friendly to the environment. The construction scale will be annually 100,000 tons.
Comment: This project is projected to have an annual sales income of US$18,100,000, and an annual potential profit of US$9,100,000. The return term is estimated to be two and one-half years.
Contact: Hulunbeier Planning Development Committee
Persons in charge: Zhang Xueren and Wang Zhiming
Tel: +86-470-8252372
Fax: +86-470-8252224

No. 3: Dimethyl Ether Project
Location: Hululnbeier City, Inner Mongolia Autonomous Region
Status: Feasibility study report completed
Total investment: US$33,700,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: This project will use wood coal to produce dimethyl ether, which could be used as clean fuel for automobiles. The construction scale will be 20,000 tons a year.
Comment: The annual sales income is projected to be US$24,000,000, and the profit potentially US$7,600,000 a year, with an investment return rate of 31.73 percent, and an internal return rate of 26.37 percent. The return term is estimated at five years.
Contact: Hulunbeier Planning & Development Committee
Persons in charge: Zhang Xueren and Wang Zhiming
Tel: +86-470-8252372
Fax: +86-470-8252224

No. 4: Biological Compound Fertilizer Project
Location: Wuhai City, Inner Mongolia Autonomous Region
Status: Feasibility study report finished
Total investment: US$970,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: This project will use the waste of coal mining as resource to produce fertilizer. The annual production scale will be 30,000 tons.
Comment: The annual sales income is estimated at US$970,000, and the associated profit estimated to be US$1,400,000 million before taxes. The return term is projected at three years.
Contact: Shuangyuan Co. Ltd. of Wuhai City
Person in charge: Li Ziming
Tel: +86-13904731522
Postal code: 016000

No. 5: Fly-Ash Integrated Utilization Project
Location: Chaoyang City, Liaoning Province
Status: Information not available
Total investment: US$500,000
Funding source: Information not available
Cooperation form: Cooperation, joint venture, or sole investment
Brief description: This project will produce 1 million square meters of wall materials, with the usage of powdered coal ash as the raw material.
Comment: The construction period will be two years, while the estimated return term will be three years with an estimated annual profit of US$3,600,000.
Contact: Local Government of Longcheng District, Chaoyang City
Person in charge: Zhang Aijun
Tel: +86-421-3810681
Fax: +86-421-3814493
Address: 8 Zhongshan Street, Chaoyang City, Liaoning Province
Postal code: 122000

No. 6: Chemical Projects in Chemical Industry Park
Location: Cangzhou City, Hebei Province

Status: Information not available
Total investment: US$3,628,000,000
Funding source: Information not available
Cooperation form: Cooperation, joint venture, or sole investment
Brief description: These projects are all located in Lingang Chemical Industry Park. They include 9 coal chemical projects, 27 ethylene projects, 14 propylene projects, 25 benzene projects, 25 other projects.
Contact: Lingang Chemical Industry Park of Cangzhou City

No. 7: Biological Pesticide Project
Location: Jiangsu Province
Status: Proposal submitted for approval
Total investment: Information not available
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: The project will have a capacity of 1,000 tons per year. The products are friendly to the environment.
Comment: The annual sales income is estimated to be US$4,900,000, and the associated profit projected to be US$980,000 before taxes. The return term is estimated at one year.
Contact: Shennong Group Co. Ltd. of Jiangsu Province

No. 8: Sodium Carbonate Project
Location: Xuzhou City, Jiangsu Province
Status: Feasibility study report finished
Total investment: US$3,900,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: The project will use advanced technology to produce sodium carbonate, and the construction scale will be annually 100,000 tons.
Comment: The annual sales income is projected at US$3,600,000
Contact: Tongshan Fertilizer Plant

No. 9: Reconstruction of Aluminum Fluoride Project
Location: Baiyin City, Gansu Province
Status: Feasibility study report under preparation
Total investment: US$19,300,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: The key technologies and equipment will be imported from Switzerland, and the construction scale will be 30,000 tons a year.
Comment: The annual sales income is estimated to be US$24,700,000, and the associated profit estimated at US$6,700,000 before taxes, with an investment return rate of 15.8 percent. The return term is projected at nine years.
Contact: Baiyin Fluoride Co. Ltd.
Person in charge: Wang Yan
Tel: +86-943-8224902
E-mail: *LTDZ@baiyin-window.com*
Address: Renmin Road 168, Baiyin City, Gansu Province
Postal code: 730900

Pulp and Paper Industry

No. 1: Paper Wood Pulp Project
Location: Xianghe County, Hebei Province
Status: Information not available
Total investment: US$19,300,000
Funding source: Foreign investment (US$12,000,000)
Cooperation form: Cooperation or joint venture.
Brief description: Deforestation is restricted according to the law in China. Therefore, limited lignum can be raw material for the pulp and paper industry. Senxinlin Group Co. plans to plant fast-growing poplars and use these trees to produce paper. The construction scale will be 100,000 tons annually.
Contact: Senxinlin Group Co. Ltd. of Xianghe County
Person in charge: Lin Jianhui
Tel: +86-316-8317115

No. 2: Paper Dishware Project
Location: Jiexiu City, Shanxi Province
Status: Information not available
Total investment: US$1,200,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: This is an environmentally protected project. It will produce 340,000 pieces of paper dishware per year.

Comment: The annual sales income is projected to be US$1,300,000, and the associated profit estimated to be US$300,000 before taxes.
Contact: Shanxi Jiexiu Paper Production Plant
Persons in charge: Shi Aixi and Tian Yeshi
Tel: +86-354-7222751,7223130
Postal code: 031200

No. 3: Special Paper Production Project
Location: Luohe City, Henan Province
Status: Proposal is under preparation
Total investment: US$17,000,000
Funding source: Enterprise (US$5,000,000), foreign investment (US$12,000,000)
Cooperation form: Cooperation or joint venture.
Brief description: The project will introduce advanced technologies to produce special paper.
Comment: The annual sales income is estimated to be US$544,000,000, and the accompanying profit estimated at US$6,000,000 after taxes, with an estimated return term of five years.
Contact: Yinge Industry Stock Company
Person in charge: Dong Liangkai
Tel: +86-395-2355464
Fax: +86-395-2355464
E-mail: *Yghlk@sohu.com*
Postal code: 462000

Textile Industry

No. 1: Multifunction Natural Costuming Project
Location: Jining City, Shandong Province
Status: Feasibility study report under preparation
Total investment: US$22,900,000
Funding source: Foreign investment (US$10,300,000), enterprise (US$12,600,000)
Cooperation form: Cooperation, joint venture, equipment import, or BOT
Brief description: This project will use advanced process to produce many kinds of cloth.
Comment: The construction period will be one year, amd the estimated return term will be three years. The annual sales income is projected at US$69,880,000, with a projected investment return rate of 33 percent.
Contact: Ruyi Textile Group Co. Ltd. of Shandong Province.
Persons in charge: Chen Ertai and Xu Guoming
Tel: +86-537-2316184
Fax: +86-537-2314528
E-mail: *invest@sd163.net*
Address: Eastern Hongxing Road 96, Jinan City, Shandong Province

No. 2: Chemical Fiber Garment Production Line Renovation Project
Location: Zhengzhou City, Henan Province
Status: Proposal under preparation
Total investment: US$21,000,000
Funding source: Foreign investment (US$10,500,000)
Cooperation form: Cooperation or joint venture.
Brief description: This is a technical renovation project. The capacity will be 14 million meters per year.
Comment: The return term is projected to be four years.
Contact: First Textile Co. Ltd. of Zhengzhou City
Person in charge: Chen Mingxing
Tel: +86-371-7224021
Fax: +86-371-7632868
Address: Western Mianfang Road 4, Zhengzhou City, Henan Province

No. 3: "Green" Cloth Project
Location: Weihai City, Shandong Province
Status: Information not available
Total investment: US$1,500,000
Funding source: Foreign investment (US$900,000)
Cooperation form: Cooperation or joint venture
Brief description: The products are healthy and safe to human beings, and the capacity will be 1,500 tons of cloth per year.
Comment: The projected return term is three years.
Contact: Silk and Textile Industry Co. Ltd. of Weihai City
Persons in charge: Zhong Baoqing and Qiu Zhujie
Tel: +86-631-6622980
Mobile: +86-13326301519, +86-13863180837
E-mail: *WSZ@public.whptt.sd.cn*
Address: Huanshan Road 1, Rushan City, Shandong Province
Postal code: 264500

Metallurgic Industry

No. 1: Thin Copper Foil Project
Location: Baiyin City, Gansu Province
Status: Feasibility study report under preparation
Total investment: Information not available
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: This is a high-tech project with high added value. It will produce 3,000 tons of copper foil.
Comment: The return term is projected at seven years. The estimated annual sales income is US$10,900,000, and the estimated profit is US$3,600.000 after taxes, with an investment return rate of 17 percent.
Contact: Baiyin Non-ferrous Metal Co. Ltd.
Persons in charge: Zhang Yuquan and Yang Jie
Tel: +86-943-8812426, 881217
Postal code: 730900

No. 2: Alloy Production Technical Renovation Project
Location: Shijiazhuang City, Hebei Province
Status: Feasibility study submitted for approval
Total investment: US$25,000,000
Funding source: Foreign investment (US$15,000,000)
Cooperation form: Cooperation or joint venture
Brief description: This project will upgrade the traditional process to meet the requirements of market. The equipment needed will be imported from foreign countries.
Comment: The return term is projected to be four years. The estimated annual sales income is US$159,630,000, and the profit estimated at US$7,250,000 after taxes.
Contact: Shijiazhuang Steel Co. Ltd.
Person in charge: Wang Liping
Tel: +86-311-5052577-2007
Fax: +86-311-5674170
E-mail: *public@hebiic.gov.cn*
Postal code: 050000

No. 3: Chlorinated Polyvinyl Chloride Project
Location: Jining City, Shandong Province
Status: Proposal submitted for approval
Total investment: US$33,700,000
Funding source: Foreign investment (US$24,700,000)
Cooperation form: Cooperation or joint venture.
Brief description: The capacity of this project will be 1,000 tons a year. Key equipment will be imported from Goodrich (U.S.) and Dupont (U.S.).
Comment: The estimated return term is three years, and the construction period is two years. The annual sales income is projected to be US$11,976,000, with an investment return rate of 40 percent.
Contact: Zhongyin Electrochemical Co. Ltd.
Persons in charge: Chen Ertai and Xu Guoming
Tel: +86-537-2316184
Fax: +86-537-2314528
E-mail: *invest@sd163.net*
Address: Western Taibai Road, Jining City, Shandong Province.

Food Industry

No. 1: Cattle Breeding, and Grassland Eco-construction Project
Location: Hulunbeier City, Nei Mongol Autonomous Region
Status: Proposal approved
Total investment: US$4,800,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture.
Brief description: The project will breed 6,000 heads of cattle and result in about 13.3 square kilometers of improved grassland. It will build related factories to use cattle resources.
Comment: The projected return term is four years. The annual sales income is estimated to be US$545,600,000, and the estimated profit is US$1,200,000 Yuan per year, with an investment return rate of 25.3 percent.
Contact: Responsible Organization: Taike Industry Co. Ltd. of Xinzuoqigelintai
Persons in charge: Zhang Xueren and Wang Zhiming
Tel: +86-470-8252372
Fax: +86-470-8252224

No. 2: Technical Renovation Project on Monosodium Glutamate and Flour Deep Process
Location: Wendeng City, Shandong Province
Status: Information not available.
Total investment: US$1,700,000
Funding source: Information not available

Cooperation form: Cooperation or joint venture
Brief description: The technical renovation project will expand the production capacity of monosodium glutamate and flour to 80,000 tons a year each.
Comment: The projected return term is five years, and the estimated annual sales income is US$96,700,000, with an investment return rate of 58.82 percent.
Persons in charge: Deng Rugui and Zhang Fujun
Tel: +86-631-8981116
Fax: +86-631-8451734
E-mail: *linglan@wh_public.sd.cninfo.net*

No. 3: Julep Technical Renovation Project
Location: Xuzhou City, Jiangsu Province
Status: Feasibility study report finished
Total investment: US$7,100,000
Funding source: Information not available
Cooperation form: Cooperation or joint venture.
Brief description: The project will have a capacity of 5,000 tons of julep per year.
Comment: The return term is projected at five years, with an estimated investment return rate of 25.3 percent. The construction period will be one and one-half years.
Contact: Zhaohe Industry Co. Ltd. of Xuzhou City

Other Projects

No. 1: Mechanical Manufacturing Project in an Industry Park
Location: Linfen City, Shanxi Province
Status: Proposal approved
Total investment: US$42,000,000
Funding source: Foreign investment (US$2,300,000)
Cooperation form: Cooperation or joint venture.
Brief description: The project will import DISA-230 (B) foundry process (Denmark), DISAMATCH-130 (A) foundry process (Denmark), IMF process (Italy), HWS process (Germany), and FATA "EPC" nonferrous metal foundry process (Italy). This project will annually produce 155,000 tons of automotive accessories.
Comment: The return term is projected to be three years. The estimated annual sales income is US$131,200,000, and the estimated profit is US$63,400,000.
Contact: Huaxiang Foundry Industry Group Co. Ltd. of Linfen City
Person in charge: Zheng Ailin

No. 2: Industry Park Project
Location: Jiayuguan City, Gansu Province
Status: Civil engineering completed
Total investment: Information not available
Funding source: Information not available
Cooperation form: Cooperation or joint venture
Brief description: This project will build up an industry park, with information, environmental protection, mechanical, electronic, and biological pharmacy industries as key development directions.
Comment: When the project is completed in 2010, the sales income is projected to be US$181,400,000, which includes an estimated profit of US$36,300,000 before taxes.
Contact: Management Committee of Jiayuguan Industry Park
Person in charge: Yang Liya
Tel: +86-937-6225602
Postal code: 735100

APPENDIX B

U.S. Government Contacts

U.S. Department of Commerce Offices in China

Beijing
31st Floor, North Tower
Beijing Kerry Center, No. 1 Guanghua Lu
Beijing 100020, China
Tel: +86-108-529-6655
Fax: +86-108-529-6558 or 6559
E-mail: *Beijing.Office.Box@mail.doc.gov*
Web site: *www.buyusa.gov/china/en/beijing.html*

Shanghai
Shanghai Center, Suite 631
1376 Nanjing West Road
Shanghai 200040, China
Tel: +86-216-279-7630
Fax: +86-216-279-7639
E-mail: *Shanghai.Office.Box@mail.doc.gov*
Web site: *www.buyusa.gov/china/en/shanghai.html*

Guangzhou
14/F China Hotel Office Tower, Room 1461
Liu Hua Road
Guangzhou 510015, China
Tel: +86-208-667-4011
Fax: +86-208-666-6409
E-mail: *Guangzhou.Office.Box@mail.doc.gov*
Web site:
www.buyusa.gov/china/en/guangzhou.html

Chengdu
4 Lingshiguan Lu, Renmin Nanlu Section 4
Chengdu, Sichuan 610041, China
Tel: +86-288-558-3992/9642
Fax: +86-288-558-9221/3520
E-mail: *Chengdu.Office.Box@mail.doc.gov*
Web site: *www.buyusa.gov/china/en/chengdu.html*

Shenyang
52 Shi Si Wei Road, Heping District
Shenyang, Liaoning 110003, China
Tel: +86-242-322-1198
Fax: +86-242-322-2206
E-mail: *Shenyang.Office.Box@mail.doc.gov*
Web site: *www.buyusa.gov/china/en/shenyang.html*

Hong Kong
26 Garden Road, Hong Kong
Tel: +85-22-521-1467
Fax: +85-22-845-9800
E-mail: *Hong.Kong.Office@mail.doc.gov*
Web site: *www.buyusa.gov/hongkong/*

Other Key U.S. Government Contacts

U.S. Department of Commerce, International Trade Administration, U.S. and Foreign Commercial Service

Beijing:
David Gossack: +86-108-529-6655, x807
Yi Wang: +86-108-529-6655, x837
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Guangzhou:
Mike Murphy: +86-208-667-4011
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Hong Kong:
Stewart Ballard: +85-22-521-5752
Olevia Yim: +85-22-521-6166
Mobile: +85-29-436-4300

U.S. Department of Commerce, International Trade Administration

Washington, D.C.:
- Energy and Environmental Industries
  Susan Simon: +1 (202) 482-0713
- Advocacy Center
  Roza Pace: +1 (202) 482-0679
- Market Access and Compliance
  Elise Owen: +1 (202) 482-1983

Manila, Philippines:
- Asia Development Bank, U.S. and Foreign Commercial Service Liaison
  Frank Foster: +1 (632) 887-1345

U.S. Environmental Protection Agency

Washington, D.C.:
Suzanne Giannini-Spohn +1 (202) 564-3907
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Export-Import Bank of the United States

Washington, D.C.:
Craig O'Connor: +1 (202) 565-3939
Talaat Rahman: +1 (202) 565-3911

U.S. Department of State

Beijing:
Environment Science and Technology
Debbie Seligsohn: (86-10) 65323831 x6609
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U.S. Trade and Development Agency

Washington, D.C.:
Geoff Jackson: +1 (202) 875-4357
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U.S. Department of Energy

Germantown, Maryland:
Office of Coal/Power; Import/Export Activities; Fossil Energy
Peter Rozelle: +1 (301) 903-2338
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U.S. Department of Agriculture

Washington, D.C.:
Sylvana Li: +1 (202) 690-2868

APPENDIX C

In-Country Contacts

Ministry and Agencies

Department of Science, Technology, and Standards
State Environmental Protection Administration (SEPA)
Director: Yu Dehui
Address: 115 Xi Zhi Men Nei Xiao Street, Beijing 100035, China
Tel: +86-10-67115130
Web site: *www.china-epa.com/kjs/*

Department of Environment and Resource Comprehensive Utilization
National Development and Reform Commission
Contact: Zhao Jiarong
Address: 38 Yue Tan Nan Avenue, West District, Beijing 100824, China
Tel: +86-10-68501240
Web site: *www.sdpc.gov.cn*

Administrative Center for China's Agenda 21 (ACCA21)
Contact: Wang Weizhong, Director
Address: 67, Suzhou Street, Haidian District, Beijing 100089, China
Tel: +86-10-82636193
Fax: +86-10-82636192
Web site: *www.acca21.org.cn*

China International Training Center for Sustainable Development
Contact: Tong Liang, Deputy Director
Address: 109 Wan Quan He Road, Haidan District, Beijing 100080, China
Tel: +86-10-62564400
Fax: +86-10-62588142
E-mail: *tongitc@public3.bta.net.cn*

Institutions

State Key Laboratory of Environmental Simulation and Pollution Control
Contact: Shi Lei
Address: Department of Environmental Science and Engineering, Tsinghua University, Beijing 100084, China
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Fax: +86-10-62771472
E-mail: *slone@tsinghua.edu.cn*

Institute of Process Engineering (IPE)
China Academy of Science
Address: 1, Beiertiao, Zhongguancun Road, Haidian district, Beijing 100080, China
Director: Li Jinghai
Tel: +86-10-62554241
Fax: +86-10-62561822
Web site: *www.icm.ac.cn*
E-mail: *office@home.icm.ac.cn*

China Council for International Cooperation on Environment and Development (CCICED)
Task Force on Strategy and Mechanism Study for Promoting Circular Economy and Cleaner Production in China
Contact: Qian Yi, Chinese Co-Chair
Address: 115 Xizhimennei Nanxiaojie
Beijing 100035,China
Tel: +86-10-66126793

Fax: +86-10-66151762
Web site: *www.cciced.org*
E-mail: *secretariat@cciced.org*

Industry Organizations

China National Cleaner Production Center
Address: 8 Da Yang Fang, Wa Li, Chaoyang District, Beijing 100002, China
Tel: +86-10-84915107
Fax: +86-10-84913900
Web site: *www.ccpp.org.cn*
Email: *cncpc@craes.org.cn*

Asia-Pacific Regional Center for Hazardous Waste Management Training and Technology Transfer
Contact: Jinhui Li, Director
Address: Department of Environmental Science and Engineering, Tsinghua University, Beijing 100084, China
Tel: +86-10-62782029
Fax: +86-10-62772048
E-mail: *jinhui@tsinghua.edu.cn*

Center for Environmentally Sound Technology Transfer (CESTT)
Director: Shi Han
Address: 109 Wan Quan He Road, Haidian District, Beijing 100089, China
Tel: +86-10-82636607 or 6021
Fax: +86-10-82636017
Web site: *www.cestt.org.cn*
E-mail: *cestt@acca21.edu.cn*

Technical Center for Cleaner Production of Metallurgical Industry
Contact: Yang Xiaodong
Address: 4, Bai Guang Road, Beijing 100053, China
Tel: +86-10-8385-7514
Fax: +86-10-8385-7514
E-mail: *yangxiaodong@ceris.net.cn*

Cleaner Production Center of Chemical Industry
Contact: Qi Hongwei,
Address: P.O. Box 1442, He Ping Li, Chaoyang District, Beijing 100013, China
Tel: +86-10-64287757
Fax: +86-10-64287757
E-mail: *cccpcp@public.bta.net.cn*

SINOPEC Cleaner Production
Contact: Pu Shujun
Beijing Design Institute of China General Petrochemical Corporation
P.O. Box 3013
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Tel: +86-10-62028822-71701 or 82301
Fax: +86-10-62014932

Liaoning Cleaner Production Center
Director: Qiu Weiguang
Address: No. 34, Chong Shan East Road, Shenyang 110032, China
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Fax: +86-24-8662-5243
Web site: *www.lncpc.com.cn*
E-mail: *ich_cp@tom.com*

Hong Kong Productivity Council
Contact: David Feng
Address: Hong Kong Productivity Council Building, 78 Tat Chee Avenue Kowloon, Hong Kong
Tel: +852-27885619
Fax: +852-27885608
Web site: *www.hkpc.org/hkcpc*
E-mail: *davidf@hkpc.org*

Jiangsu Environmental Science Academy (Jiangsu Cleaner Production Center)
Director: Zhang Limin
Address: 241 Fenghuang West Street, Nanjing 210036, Jiangsu Province, China
Tel: +86-25-6660952
Fax: +86-25-6503113

Gansu Cleaner Production Center
Contact: Zhao Huihong
Address: 123 Gaolan Road, Chengguan District, Lanzhou 730030, China
Tel: +86-931-8412105
Fax: +86-931-8418551
E-mail: *Zhao_hh@gsemail.net*

Other Entities

Longyuan Environmental Company
Address: 1 Er'tiao Bai Guang Road, Xuanwu District, Beijing, 100761, China
Tel: +86-10-63416400
Fax: +86-10-63531234
Web site: *www.lyhb.cn*

APPENDIX D

Information and Reference Resources

Web Sites

General Environmental Sector Web Sites

State Environmental Protection Administration of China
www.zhb.gov.cn

- News of national environmental protection
- Introduction to SEPA and SEPA Affiliate Units
- Environmental protection planning, reports, regulations and standards in China made by SEPA and affiliate units
- Publication of environmental evaluations and the supervision and execution of environmental protection
- Introduction to International cooperation
- Links to Web sites of other related units and organizations

National Development and Reform Commission
www.sdpc.gov.cn

- Introduction to the compositions, frameworks, and functions of National Development and Reform Commission and its affiliate units
- Introduction to provincial development and reform commissions and price bureaus
- Introduction to national development plans in energy, transportation, and social causes
- News and information of national planning, programming, policies, and public bidding
- Introduction to national debt investments and the efforts
- Links to Web sites of other ministries and administrations

Ministry of Water Resources
www.mwr.gov.cn

Ministry of Construction
www.cin.gov.cn

Ministry of Commerce
www.mofom.gov.cn

Cleaner Production Web Sites

China Cleaner Production
www.ccpp.org.cn

- The site is hosted by the Department of Science and Standard of State Environmental Protection, Administration of China, and China National Cleaner Production Center
- Background of cleaner production, including the definition and objectives of cleaner production
- Introduction to cleaner production progress in China and other countries
- News about cleaner production in China
- Introduction to cleaner production policies and standards

- Introduction to cleaner production managements, pollution prevention technologies, and cleaner production audit
- Some cases of international cooperation
- Links to other Web sites about cleaner production and environment protection

Cleaner Production in China
www.chinacp.org.cn

- Originally developed as the project Web site for the CIDA financed Canada-China Cooperation Project in Cleaner Production
- Developed by the National Development and Reform Commission, which responsible for the implementation of cleaner production
- Information in both Chinese and English on cleaner production, on China's cleaner production policy and legislation, and on existing and planned activities to implement cleaner production in China
- Information on other organizations in China responsible for various aspects of implementing cleaner production or combating of pollution, on foreign donors, and on projects with foreign financing
- Case studies and audit reports carried out in factories in various sectors as well as profiles of factories implementing cleaner production
- Links to English-language sites of general interest in the field of cleaner production

China Resources Conservation and Environmental Protection
www.drccu.gov.cn

- Sponsored by the Department of Resources Conservation and Comprehensive Utilization, former State Economic and Trade Commission
- Special topics including resources conservation and environmental protection
- Introduction to environmental protection laws, policies, planning, regulations, standards, technological development, and cases studies
- Information to environmental protection hotspots
- News and information about resources conservation and environmental protection issued by ministries, commissions, and provincial administrations
- Statistical data on national resources conservation and environmental protection
- Links to Web sites of other related units and organizations

China Environmental Resources Information
www.cern.gov.cn

- Directed by the Department of Environment and Resource Comprehensive Utilization in the National Development and Reform Commission.
- Special topics cover sustainable development, pollution control and prevention, cleaner production, energy efficiency, water conservation, comprehensive utilization, and recycling economy
- Introduction to the department and laws, regulations, and develop plans
- Technological development and products
- Investment and financing information
- Information on international cooperation
- News in the field about resources, comprehensive utilization, and environmental protection
- List of relative publications, including a newsletter, *Environment and Resources*

China Energy Conservation Information
www.secidc.org.cn

- Sponsored by Energy Conservation Information Dissemination Center of China
- Introductions, news, and case studies of energy conservation information
- Introduction of related policies, rules, and regulations
- Introduction to the Energy Conservation Information Dissemination Center, State Economic and Trade Commission

- Information to Conference on Energy Conservation
- Journals and magazines with energy conservation information
- Links to Web sites of other related units and organizations

Liaoning Cleaner Production Center
www.lncpc.com.cn

- Introduction to Liaoning Cleaner Production Center
- News about cleaner production and environment protection in China, especially in Liaoning
- Concepts, definitions, and objectives of cleaner production and other related subjects
- Introduction to policies and standards of cleaner production
- Introductions of cleaner production audit
- Case studies in China and other countries, especially cleaner production cases in Liaoning
- Introductions to environmental certification and evaluation
- Links to Chinese and international Web sites on cleaner production

Liaoning Integrated Environmental Programme: EU–China
www.eu-liep.org

- Background introduction to Liaoning in history, weather, population, economy, and cities
- Introduction to EU-China LIEP, including its components, activities, and tendering
- Hot issues discussion and related publications introduction
- Links to related program Web sites, national environmental Web sites and international environmental Web sites

Environmental Industry Sites

China Environmental Protection Industry Online
www.cepiol.com

- Sponsored by the China Association of Environmental Protection Industry
- News of Environment Protection and Cleaner Production
- Introduction to SEPA, China Association of Environmental Protection Industry, and other related special committees
- Introduction to government documents, environmental certifications, projects examination, and approval
- Information about commercial activities, including new products, new companies, and environmental exhibitions
- Introduction to international environment protection technologies
- Special topic discussions
- Links to related Web sites

Center for Environmentally Sound Technology Transfer
www.cestt.org.cn

- Information on environmentally sound technologies and cases
- Information on conferences, exhibitions, and training program
- Introduction to environmental technologies and products
- Web sites of cooperating companies and organizations

China Sustainable Development Information Sharing Network
www.estinfo.net.cn

- Directed by the Administrative Center for China's Agenda 21 (ACCA21) and Center for Environmentally Sound Technology Transfer
- Introduction to environment protection technologies and equipments

  Case studies of cleaner production

- Newest information on environment protection organizations and companies
- Environmental information databases

China Environmental Equipments Network
www.goepe.com

- Commercial information on environmental protection
- National and international environmental protection activities
- Introductions to environmental companies and products
- Introductions to environmental protection technologies

China Project Network
www.bhi.com.cn

- Introduction to engineering projects being planned and developed, especially major projects
- News about commercial activities
- Project investments policies, industry analysis reports, and special investigations
- Information on exhibitions
- Links to Web sites of related and cooperating units and organizations

China Economic Information Network
www.cei.gov.cn

- Directed by the State Information Center, which provides economic information on China
- News, reports, analysis, policies and regulations, and statistics on the Chinese economy
- Special topics and forums on the Chinese economy
- Economical Information on different industries
- Provincial economic information

China Investment Network
www.china-138.com

- Information on regional investment projects and enterprise investment invitation projects
- Introductions to developing zones in China
- Introductions to policies and procedures
- Focus analysis of invitations to outside investors
- Links to related web sites of units, organizations, and commercial entities

Bibliography of Key Documents and Other Materials

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Date: 2003

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Editor: Germany Technical Cooperation Company and Zhejiang Cleaner Production Center
Date: 2003

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Editor: Editorial Office of the China Environment Protection Industry
Sponsor: China Association of Environment Protection Industry

China Environmental Protection Industry Information Communication (Journal)
Editor: China Association of Environmental Protection Industry

Guidebook on the Market Supply and Demand of China Environmental Industry
Editor: China Association of Environmental Protection Industry, Department of Science, Technology and Standards, State Environment Protection Administration

Publisher: China Environment Science Publishing House
Date: 2002

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Editor: China Environment Yearbook Editorial Board
Publisher: China Environment Yearbook Publishing House
Date: 2000

Evaluation on Technology and Equipment in China Environment Protection Industry
Editor: China Association of Environmental Protection Industry
Publisher: China Environment Science Publishing House
Date: 2000

Case Study of Cleaner Production Promotion in Enterprises
Editor: Department of Resource Conservation and Comprehensive Utilization, State Economic and Trade Commission
Publisher: China Jiancha Publishing House
Date: 2000

An Introduction to Cleaner Production
Editor: Department of Resource Conservation and Comprehensive Utilization, State Economic and Trade Commission
Publisher: China Jiancha Publishing House
Date: 2000

Cleaner Production Audit Guideline for Enterprise
Editor: Department of Resource Conservation and Comprehensive Utilization, State Economic and Trade Commission
Publisher: China Jiancha Publishing House
Date: 2000

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Editor: Department of Resource Conservation and Comprehensive Utilization, State Economic and Trade Commission
Publisher: China Jiancha Publishing House
Date: 2000, 2003

Questions and Answers for Cleaner Production Promotion Law
Editor: Department of Resource Conservation and Comprehensive Utilization, State Economic and Trade Commission
Publisher: Xue Yuan Publishing House
Date: 2003

Cleaner Production News in Chemical Industry
Publisher: Cleaner Production Center of Chemical Industry

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Publisher: China Association of Environmental Protection Industry
Date: 2003

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(report no. 25141)
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Date: January 2003